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*PLANT PATHOLOGY: A RETROSPECT AND PROSPECT.**

THE study of plant diseases has made remarkable progress within the last two decades. This is commented upon at home and abroad. Perhaps in no field outside of organic chemistry or of animal pathology and bacteriology have the advances been greater. In casting about for a subject, it has seemed to the speaker therefore that perhaps he could not do better in the time allotted to the presidential address than to consider, first, the state of plant pathology prior to the year 1880; second, the progress which has been made from that time to the present; and, third, some of the problems which now confront the investigator. Nothing beyond a popular sketch is contemplated.

The twenty years preceding 1880 were years of stress and uncertainty in the biological world. Pasteur and Cohn had laid the foundations of modern bacteriology and the whole world was agog with interest over the new doctrines of fermentation and of disease. Sachs and de Bary had done equally magnificent work in plant morphology and physiology. But the great masters were not having everything their own way. Hallier and Billroth in Germany were upholding a crazy doctrine of

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the polymorphism of species whereby an organism could change into, practically, whatever happened to grow in its vicinity; while Pouchet in France and Bastian in England were maintaining the spontaneous generation of minute organisms in sterile liquids with great vigor and a considerable following, if not with much logic. Everywhere the old, well-intrenched theories of disease were in conflict with the new. During the whole of this period the doctrines of Darwin were opposed and fought over with a pertinacity and a rancor scarcely to be appreciated by the younger men of this generation. Evolution has now become our watchword, but even yet we do not fully appreciate what it means, or at least we often speak and write as if we did not. It is too large a thought, and we are still entangled in the language of our ancestors. Especially do we not fully appreciate the molding influence of environment, *i. e.*, the plastic nature of the living organism under the action of changed conditions.

Prior to the year 1880, laboratory methods for the study of fungi and bacteria were not well developed. In the first place, there was no exact and convenient method for obtaining pure cultures and, in the second place, the microscope was still the principal instrument of research. The few experiment stations in this country and those in Europe were, for the most part, plodding along in a perfunctory way, without good equipments and with little money for botanical inquiry, and the study of plant diseases was scarcely thought of outside of a few university laboratories, and rarely in these with anything practical in mind for the benefit of agriculture. The main thing considered was the parasite rather than the host plant, and the technique for the study of both was of the simplest sort. We had no precise fixing and staining methods, no fine microtomes with their yards of serial sections, no synthetic culture media, no elaborate sterilizing ovens and brood chambers, and no apochromatic glass for lenses. 'Pure cultures' were practically unknown, and photography and photomicrography had not yet become arts of daily use in the laboratory.

Prior to 1880 we had indeed the brilliant researches of Louis Pasteur on a variety of subjects of wide interest to biologists, if not bearing directly on plant pathology. Berkeley had already done some good work on plant diseases in England, although most of his efforts had been devoted to systematic mycology. Tyndall in England had also done much to clear away the fog produced in the public mind by the adherents to the doctrine of spontaneous generation. Kühn, Sorauer, Frank and Hartig had begun their studies in Germany. But it was especially to de Bary, in Germany, that all eyes were turned as the great master mind. He had published a series of brilliant papers on the life history of various fungi, and was stimulating many of the younger men to undertake a higher type of research work than was then in vogue. Among these men, Woronin deserves especial mention. He published several fine papers in conjunction with de Bary and has continued the good work independently. In our own country, Dr. Farlow had published a number of interesting papers from the Bussey Institution on black knot and other diseases of plants, and there was some mycological work with an economic aspect going on under Dr. Burrill's direction at the University of Illinois, and under Dr. Bessey's direction at Ames, Iowa. In Europe and America, a number of younger men, who have since become widely known, were just beginning their work on diseases of plants.

Plant pathology was not an attractive profession in those days. When he first desired to make the diseases of plants, or mycology, as we called it, his chosen pro-

fession, the speaker well remembers casting his eye over the field very dubiously. There were no places for such workers, and, from the pecuniary side, it was a barren and unsatisfactory prospect. Nevertheless, the field was so inviting in other ways that it appeared to be worth while to run the chances. A meager livelihood in the pursuit of a most attractive line of work seemed preferable to a mint of money earned in an irksome profession, and so the die was cast.

How changed is the present outlook! At present, and for some time to come, the demand for well-trained plant pathologists (in this country, at least) is likely to be considerably in excess of the supply. By this I do not mean that there are not already enough, and more than enough, of second and third-rate workers; and I would not advise any one to enter the field who has not a marked talent for this line of inquiry, robust health, good training, and a determination to do superior work.

Of course, the magnificent development of bacteriology and animal pathology within the last twenty-five years has had its influence upon the study of plant pathology, as it has had upon all related sciences, but it does not seem to have exerted as great an influence or as immediate an influence as one would have supposed. In general, botanists were the ones upon whom the investigation of plant diseases naturally devolved, and most of them for some reason were very slow to make use of the exact methods of research which have led to such brilliant results in the study of human and animal diseases. However, as time has passed, more and more men have learned how to study plant diseases, and a considerable body of plant pathologists, although by no means all, are no longer open to the charge of not knowing how to pursue pathological researches.

Inasmuch as we have always had plant diseases with us, the query is sometimes raised why it is that the exact study of such diseases was postponed until the end of the nineteenth century. The primary reason, no doubt, is that exemplified over and over again in the history of the world, viz., that one branch of research must often wait for the development of some other branch. In this case, inquiry into the causes of many diseases had to wait for an exact method of isolation of the parasites and a knowledge of how to grow them in pure cultures. It now seems to us a very simple matter to separate one organism from another by means of poured gelatin or agar plate cultures. It seems, also, a very near discovery that discontinuous sterilization for a short time on three successive days should render a culture medium sterile, and that the simple intervention of a sterile cotton plug between this medium and the open air should suffice to strain out all the floating organisms of the air and keep the medium indefinitely sterile. That the study of the causes of certain diseases should have to wait many years until these simple facts had been demonstrated and a knowledge of them diffused among men is not less true than it is remarkable. The whole science of bacteriology and all the wonderful advances that have been made in the etiology of obscure diseases really date from the time when we were first able, with some degree of ease and exactness, to separate out one kind of organism from another and grow it indefinitely in pure cultures, all of which has come to pass since the year 1880. Only the crude beginnings of bacteriology were earlier than 1880. Prior to that time we had, it is true, the fractional and dilution methods of isolation, but these, although capable of yielding good results, are troublesome and have never appealed very strongly to the mass of workers.

In the time of which I speak, there were already many excellent helps in the way of treatises on fungi. We had, for instance, the splendid volumes of the 'Selecta Fungorum Carpologia' by the brothers Tulasne, and if we were not always sure of the Latin construction, we could at least read the magnificent copper plates which embellish these volumes. There were also books by Persoon, Corda, the Nees von Essenbecks, de Notaris, Rabenhorst, de Schweinitz, Fuckel, Bonorden and Montagne. There were numerous volumes by the Swedish mycologist Frieze. We had lso Berkeley's 'Outlines,' Cook's 'Handbook of British Fungi,' and many scattered descriptions by Oudemans, Magnus, Schroeter, Winter, Berkeley, Cook, Ellis, de Thuemen, Rehm and others, in *Hedwigia* and other journals. The Italian Saccardo had not yet begun his monumental compilation of all known species of fungi, but he was printing the first parts of his 'Fungi Italici.' Several parts of Brefeld's 'Untersuchungen' also appeared prior to 1880, and there was an excellent 'Handbuch' of cryptogamic plants by Luerssen. There were also some good exsiccati, including, in this country, the first centuries by Ellis. De Bary's 'Comparative Morphology and Biology of the Fungi,' and the splendid cryptogamic 'Floras' by Winter, by Schroeter and by Oudemans had not yet appeared.

In the matter of plant diseases, we were much less well provided. In fact, there was scarcely anything in English in the nature of a general treatise. The nearest approach I can recall was a brief chapter on diseases caused by fungi in Berkeley's 'Outlines of British Fungology' (1860), and a little book by M. C. Cook entitled 'Rust, Smut, Mildew and Mould' (1865). A knowledge of foreign languages was even more essential in that day than it is now for the study of diseases of plants. Even in European tongues there were comparatively few useful general works on diseases of plants. We had, it is true, the rare, largely neglected, and generally negligible, crude, early works of Re, Unger, Meyen, Hamel and Hallier. There was also the first edition of Sorauer's 'Pflanzenkrankheiten' (1874), and Winter's little book of a dozen chapters, which appeared in 1878. This book, which described some of the commonest diseases of plants, is now quaint and old-fashioned reading, but it then seemed a model in its way. In 1878 there also appeared a little book by de Jubainville and Vesque on 'Les Maladies des plantes cultivées, des arbres fruitièrs et forestièrs, produites par le sol,—l'atmosphere,—les parasites végétaux, etc., d'après les travaux de Tulasne, de Bary, Berkeley, Hartig, Sorauer, etc.' There was also an earlier and very good book for its time by Kühn (1858).

A few diseases had been worked up quite carefully as to their etiology, and in the doing of this the way was blazed for the critical study of other and different diseases, and also, of course, for a great deal of inference and uncertain speculation. I refer to de Bary's classical work on the potato rot fungus (*Phytophthora infestans*), Farlow's work on the mildew of the grape (*Peronospora infestans*) and the black knot of the plum and cherry (*Plowrightia morbosa*), Woronin's work on the club root of the cabbage (*Plasmodiophora brassicæ*), de Bary's discoveries with reference to the heterocism of the grain rust (*Puccinia graminis*), Cornu's studies of the *Phylloxera* of the vine, Fischer von Waldheim's studies of certain of the grain smuts, and similar papers. The rusts and smuts, and the downy and powdery mildews, were the best-known parasites. Certain fungi then supposed to be pure saprophytes are now known to be active parasites, *e. g.*, certain members of the form-

genus *Alternaria* and of the form-genus *Fusarium*.

Very little was known relative to the treatment of plant diseases beyond the fact that mildews in hothouses were supposed to be induced by draughts of cold air and to be partially preventable by the use of sulphur dust; that wheat smut appeared to be partially controllable by soaking the seed-wheat in a solution of copper sulphate, and that sulphur dust was a remedy for *Oidium* of the vine.

Little or nothing was known with regard to varietal or individual resistance of plants. In a general way, it had been observed by many that, under what seemed identical conditions, some plants sickened while others remained healthy, but it was quite generally believed that this was due to the fact that there had been no good opportunity for the fungus to infect the plant, rather than that the plant itself had any special power of resistance. This idea was yet unborn, or, at least, had not come to any prominence among pathologists.

Among the great mass of farmers and other growers of plants, the rusts, smuts, mildews, etc., were accepted as the will of God, or as a matter of course, and it never entered their heads that anything could be done to lessen the ravages of these troubles.

Nothing whatever was known about bacteria as the cause of plant diseases except to two or three workers who were just beginning their studies in this field. I refer especially to Burrill in America and Prillieux in France. It was also not generally recognized that algæ could cause disease in plants. Little or nothing was know about enzymes, ions, cell nuclei or symbiosis as important factors in plant life.

Let us now for a few minutes glance at what has been accomplished in the last twenty years. From being a mere rule of thumb, plant pathology has become a well-established branch of botanical science, the study of which has been pursued in many places with astonishing ardor and excellent results. Among others, the following authors have published general works on plant diseases within the period named: Sorauer, Frank, Hartig, W. G. Smith, Kirchner, Scribner, Ward, Comes, Prillieux, von Tubeuf, Massee. Sorauer, Frank, Hartig and Ward have published several different books on plant diseases. Books by Hartig and von Tubeuf have been translated into English, and Kirchner's book has recently been done into Italian. In some cases elaborate treatises have been written on the diseases of small groups of plants, *e. g.*, Viala's 'Diseases of the Vine' (three editions), and Erickson's 'Grain Rusts.' Sorauer and Kirchner have also both published atlases of plant diseases, illustrating the more common diseases with colored figures, which, however, in many cases, it must be confessed, could be improved upon. In this enumeration the extremely useful 'Host Index' by Farlow and Seymour should not be forgotten, nor Sturgis' compact 'Bibliography.'

In the publication of authoritative general treatises on plant diseases, the United States has not kept pace with Germany. Scribner's little book on 'Fungous Diseases of the Grape, etc.' (1890), is all that I can recall. That no book at all comparable with the handbooks of Sorauer, Frank, Kirchner or von Tubeuf has yet appeared in the United States is a matter for some wonder, considering the number of us who are affected with an itch for writing. It is also a matter for regret, considering the extent of our territory, the number of our plant diseases, and the character of our population. There is now a demand in this country for several good manuals of phytopathology, and these books are the more to be desired because European manuals only very imperfectly outline American

conditions. Who will be the first to enter the field with something really excellent? Surely we ought to expect something rather better than the books I have named. A special exhortation to do well is hereby extended to the first man to occupy the field, since, if he sets the standard high, all the others must rise to his level, and the general gain will be great.

As an illustration of the growth in the United States of this branch of science, I may be permitted to cite the fact that when the speaker entered the United States Department of Agriculture at Washington in 1886, this line of work had only recently been separated from the ordinary botanical work of the department, which then consisted principally of answers to correspondents, and species descriptions of grasses. At that period, and for some time to come, we had no laboratory facilities and scarcely any place we could call our own. A little cubbyhole was apportioned off for the chief, Professor Scribner, and his assistant was allowed, by courtesy of Dr. Marx, the department artist, to occupy a desk in his room. We had very few books, and nothing in the way of apparatus beyond the simplest sort of microscopes. Now, under direction of this same United States Department of Agriculture, we have several more or less well-equipped laboratories in Washington, one in California, one in Florida and one in the Middle West at St. Louis. The number of men employed, including those who are working with us in the closely related and frequently overlapping fields of plant physiology and plant breeding, and exclusive of clerks, typewriters, artists and laborers, is twenty-six. The amount of money appropriated by Congress for this line of work in 1887 was $5,000; the sum named as necessary in the estimates of the Secretary of Agriculture for the coming year is $118,000.

As to places for the study of plant diseases, we now have in this country about fifty experiment stations where such diseases are studied or may be studied, and perhaps half as many colleges and universities, where more or less attention is given to the subject. No great university has yet done itself the honor to establish a distinct chair of plant pathology, but the subject is such a large and important one that this must unquestionably follow within a few years. More attention should, I think, be given to the proper teaching of this subject in colleges and universities. While perhaps the study of plant diseases has had a larger development in this country than anywhere abroad, owing to the fostering care of the National Government, there are nevertheless many places in other parts of the world where such diseases are now studied. I might mention the dozen or more experiment stations in Italy, in nearly all of which something has been done on this subject; the numerous places in Germany, in universities and agricultural colleges, and now recently in the laboratory of the Imperial Government Board of Health, under the able leadership of Dr. von Tubeuf; similar places are now provided in France, England, Russia, The Netherlands, Sweden and other European countries, for the study of plant diseases. There is also considerable activity in Japan, in Australia, in Java and in various other parts of the world.

The result of this is that a large body of young men has undertaken the study of this class of diseases, and the literature of the subject is now extensive. It is also, unfortunately, so scattered through journals, transactions, agricultural papers, etc., that one must read very widely if he would undertake to keep pace with the advances which are being made. This, of course, has its great disadvantages, and one sometimes wishes that the Latin tongue had been

retained as the universal language of science, or that some one language could be agreed upon in which the abstracts of all scientific papers should be published as a prerequisite to international recognition, or at the very least, that the authors of all important papers would follow the good example set by some of the Japanese and Russian writers. These men publish with their papers a summary in some other language. Such summaries need not be long. They should be, preferably, in English, German or French, since these are the leading scientific languages of the world, so far as quality and bulk of publication are concerned.

Of special journals devoted to plant pathology there were none twenty years ago; now there are five or six. Very many of the general journals of botany also now publish long papers on diseases of plants.

The time is too brief to cite all of the interesting special papers which have appeared during the last twenty years, even if it were desirable. I may, however, mention the following as interesting examples of what has been done at home and abroad. First, perhaps, in importance comes de Bary's pioneer paper on *Sclerotinia* and sclerotinial diseases. Hartig has published numerous very interesting papers on the diseases of trees and of timber. Woronin published a beautiful paper on *Tubercinia trientalis* and several equally interesting ones on sclerotinial diseases. Sadabeck and Johanson have added much to our knowledge of the *Taphrinas*. Frank has published several interesting communications on a *Gnomonia* disease of the cherry, in which he not only points out the cause of the disease, but also a remedy for the same. Burrill and those who followed him have worked out conclusively the etiology of pear blight. Savastano, Cavara and others have done the same for the olive knot. Many other diseases have also been shown to be due to specific bacteria, one of the best recent papers being by Jones, of Vermont, on a soft rot of the carrot and other plants. Brefeld has shown for many of the smuts that they can vegetate for long periods in forms resembling yeasts. In a magnificent paper on corn smut the same author has shown clearly that, unlike most smuts, the pustules appear in about fourteen days from the time of infection, and that only young, actively growing tissues can be infected. Ward in a remarkably fine paper showed a certain lily disease to be due to *Botrytis*. Woods has brought a whole class of diseases into prominence by demonstrating the spot disease of carnations to be due to insect punctures. Various workers have shown that insects and mollusks are frequently the indirect cause of disease by carrying bacteria and the spores of parasitic fungi from diseased to healthy plants. Galloway demonstrated the early blight of potatoes to be due to an *Alternaria*. Peglion in Italy proved a destructive spot disease of muskmelon to be due to another *Alternaria*. Dorsett has demonstrated that a third species causes the vexatious spot disease of violet leaves. Barclay, Plowright, Schroeter, Winter, Magnus, Klebahn, Dietel, von Tubeuf, Farlow, Thaxter, Carleton and Arthur have all contributed to our knowledge of those perplexing rusts which grow alternately on widely different plants. Erickson has demonstrated the existence on related plants of morphologically similar rusts which are incapable of cross-inoculation. Thaxter has shown that the potato scab is due to a minute fungus, *Oospora scabies*. Laurent has published two very interesting papers on the causes of immunity, one dealing with bacterial potato rots and the other with the distribution of the mistletoe in Belgium. W. G. Smith has published interesting papers on the histology of galls due to *Taphrina* and

other fungi. Cornu published an interesting paper on the grape mildew (*Peronospora*). Nawaschin has increased our knowledge of the parasite which causes club root in cabbage. Went and Beyerinck have published a number of very suggestive papers on enzymes. As already stated, this list is not designed to be complete. It might be greatly extended.

A great advance has also been made in treatments for the prevention of disease. In France, Millardet saw that the mildew did not attack certain grape vines which had been sprinkled with a mixture of bluestone and lime to prevent thefts of the grape bunches. He had the alertness of mind to recognize that here was the germ of an important method of treatment, and, with the help of Gayon, promptly elaborated it for the prevention of mildew of the grape. Following fast on the heels of this discovery was its application in France, Italy and the United States for the prevention of other fungus diseases. By the General Government, under the energetic direction of Scribner, and subsequently of Galloway, and a little later by many experiment station workers and farmers, this and similar methods of treatment were applied successfully in the United States for the prevention of the black rot of the grape, leaf spot of the pear, apple scab, and a number of other serious diseases of plants. At one time this treatment was hailed as a general panacea for all plant diseases. In Denmark, Jensen discovered that smut of various grains could be prevented by soaking the seed in hot water for a few minutes. These experiments were subsequently repeated, expanded and confirmed in this country by Kellerman and Swingle. Thaxter and Sturgis demonstrated that onion smut was only communicable during the seedling stage of growth and that, if plants were grown for a few weeks in healthy soil, they might be transplanted to fields badly infested with this smut without danger of infection. Bolley showed that the potato scab was frequently disseminated by seed potatoes, and in such cases could be controlled very satisfactorily by soaking the infected seed potatoes in a solution of corrosive sublimate. This treament is, however, not successful in case the fungus is already present in the soil. Coquilette, the entomologist, demonstrated that certain scales infesting orange trees in California could be controlled by fumigating with hydrocyanic acid gas, and Woods and Dorsett in Washington subsequently extended this treatment and applied it on a large scale, most successfully, for the freeing of hot-house plants from scale insects and aphides. This treatment has subsequently been pretty generally applied in the United States for the fumigation of nursery stock. Riley and others conceived the idea that the best method of controlling certain scales would be by multiplying their insect parasites, and the threatened destruction of the orange orchards of California by the cottony cushion scale was avoided in this way, viz., by the introduction of a lady-beetle from Australia. Giard, Snow, Forbes and others have experimented with certain fungous parasites of crop-destroying insects, hoping to spread epidemics among them, but thus far with only partial success. The dreaded San José scale can now be held in check in this country by insecticidal sprays. Potter, Halsted and others have shown that club root of cabbage may be partially prevented by heavy liming of soils. Millardet, as a result of thousands of crosses of *Vitis vinifera* with hardy American species, has obtained wine grapes resistant to *Phylloxera*. Pierce, by similar methods, has obtained a raisin grape resistant to coulure. Quite recently the Dutch in Java have largely circumvented the Sereh disease of

sugar cane by bringing healthy cuttings from the hills. Cobb pointed out a way to avoid the gumming of sugar cane, a serious disease in Australia, viz., by the selection of healthy cuttings. This practice, he informs me, has greatly reduced the amount of gummed cane in New South Wales. Orton has recently found evidence that the wilt of cotton and of cowpeas can probably be prevented by the selection of resistant individuals. Pierce and others have shown that curled leaf of the peach can be prevented by fungicidal sprays. The saving from curl in one year on one variety in one peach orchard in California was $12,700 and the estimated saving to the whole state was $400,000. Waite blazed the way for a whole series of observations on self-sterility of orchard fruits by demonstrating that a supposed pear disease infesting a great orchard in Virginia was nothing else than sterility of the flowers to their own pollen, and could be overcome by planting in the orchard an occasional pear tree of a different variety blooming at the same time or by grafting in such variety. Galloway and Dorsett have shown that the leaf spot of violets may be overcome by the selection of resistant individuals. Jones has been remarkably successsful in protecting potatoes from leaf blight by use of copper fungicides. Nearly every experiment station man has been able to chronicle some interesting treatment or important discovery.

If we consider the sentiment of the community at large respecting this kind of scientific work, the change has been equally great. From being merely 'bug hunters' and 'queer fellows,' the entomologist and mycologist have become people of importance. Farmers, fruit growers, gardeners and hothouse men are no longer skeptical or indifferent, but are eager to get the last word and quick to apply each new discovery. A recognition of the importance of plant pathology is also gradually extending to State legislatures and national bodies of legislation, and the time is not far off when appropriations for the study of plant diseases will be as prompt and liberal, in this country at least, as they are now for any line of work which is fully recognized by the men who legislate as important for the general welfare of the country and beyond the possibilities of private inquiry. Diseases which annually deplete the large civilized countries of hundreds of thousands of dollars, *e. g.*, cotton blights, grain rusts, potato rots, and which not infrequently assume an epidemic form and sweep out entire industries, *e. g.*, coffee disease of Ceylon, sugar-cane disease of Java, peach yellows of the United States, Anaheim vine disease, are certainly legitimate objects of governmental inquiry. I need not argue this point.

Some words, finally, as to the future. The prophet is always at the mercy of events. Nevertheless I shall venture a few predictions. First of all, we may predict for plant pathology in the United States during the next fifty years a wonderful development, since it appeals very strongly to the genius of our people. This being taken for granted, how shall that development be best facilitated? The facts which lie on the surface of things, as regards both the causes of disease and the treatment of the same, have now been pretty well picked up. In my judgment, the treatment of diseases by spraying with copper fungicides has reached its climax and is now on the wane. We shall have to devise other methods for dealing with many plant diseases. Plant breeding is one of the most hopeful. It is a slow process, and the man in the field will sometimes become impatient unless he is a philosopher as well as a farmer. Field hygiene is also a matter of prime importance. Suitable rotation of

crops must be practiced, and as far as possible diseased material, and the carriers of such material, must be destroyed. I lay much stress upon the last statement. Insects in particular are responsible for much more than the direct damage they cause.

The men who enter this field from now on must have a better training and a more versatile one than those who have cultivated it in time past, and the emphasis should be placed on laboratory work and laboratory training. It goes without saying that the man who would become a useful pathologist must have considerable familiarity with the literature of his subject. In other words, he must know how to use literature, and must be a linguist, or able to command linguists. He ought also to have a very considerable amount of technical training in physics and chemistry and should know something of zoology. In the way of preliminary training, eight years of university work, or its equivalent, is not too much, and a very considerable part of at least four years of this time the student should spend on organic chemistry. He must not expect to accomplish very much as a pathologist unless he has also become familiar with a very considerable body of knowledge respecting the behavior of plants under normal conditions. In other words, to be a good pathologist he must be a good physiologist, and to be a good physiologist he must first be a good chemist and physicist, for at bottom physiology rests on chemistry and physics, and the advances in this line during the next fifty years will undoubtedly be made by men who approach the problems of biology from the standpoint of physiological chemistry. Given all this, and still the man will not be eminently successful unless he is a born experimenter; I mean by this one capable of reasoning closely, and of devising ingenious methods of extorting from nature her well hidden secrets. This is, of course, asking a good deal of one man, and is more, perhaps, than can be expected of most men. Very likely a solution of the question will be found in many cases by a union of forces. No man is likely to solve these problems who approaches them from the purely chemical standpoint. Something more is required. The pathologist should be the guiding mind, but he must associate with himself a competent physiologist and one or more skilled chemists having some flexibility of mind and a decided inclination to study living things rather than dead things. The old routine ash analyses of the chemist are of no help to us. We wish to know the proximate rather than the ultimate elements of the plants we are studying, and to know how these vary in quantity and kind under changed conditions. In other words, what we wish to know is not how much carbon, hydrogen, oxygen, nitrogen, potash, phosphoric acid, etc., the plant contains, as determined by ash analyses, but in what form it exists in the living plant. We wish to know the kind and quantity of each of the organic acids, and how they vary in amount from time to time under changing conditions. We wish to know all about the sugars, the fats, the tannins, the proteids, the amids, the glucosides, the enzymes, etc., changes in all of which play an important part in nutrition and in predisposition to disease. How are these substances increased, diminished or changed by changing external conditions, either natural or of man's devising, *e. g.*, by foods added to the soil, by fungicides sprayed upon the foliage, by heat, or cold, sunshine or cloudy weather, drought or excessive precipitation? We desire to study the chemical-physiological requirements of the parasites in the same minute way. Then we shall be able to put the two kinds of evidence together and begin reasoning.

Two or three congenial men, having each his special training in the lines indicated, would be able to accomplish much more in solving the difficult problems which confront us than any single man. But I cannot divorce myself from the thought that the pathologist should himself be a chemist and a physiologist. There must certainly be a deeper study of the intimate nature of the plant in health and disease if we are to determine just what constitutes immunity in many given cases and just what is the best method of checking the prevalence of many of our most vexatious diseases. I may refer, for example, to the difficulties which lie in the way of understanding the action of even so well studied and simple a thing as Bordeaux mixture. In recent years we have heard a good deal about injuries due to the Bordeaux mixture, especially on the peach and plum. Why are these trees more susceptible than the apple and the pear or the grape? Why does Bordeaux mixture appear to be more injurious one season than another season, or in the hands of one man than in the hands of another man? Only an intimate knowledge of the nature of this substance and of the chemical physiology of the plants themselves can furnish an answer to these questions.* I may refer also to a whole group of diseases, the etiology of which mere field study and the ordinary laboratory methods do not appear to be competent to unravel; for example, the California (Anaheim) vine disease, the wilt of the orange, the sereh disease of the sugar cane, gum diseases, the yellows and rosette of the peach, the winter blight of the tomato, the internal brown spotting of potato tubers, etc. We may confidently expect that these obscure diseases will yield up their full etiology to careful study at some time in the future, but it will have to be a more thorough and exhaustive study than any that has yet been given to it and by men better trained for the solution of the special problems involved. A good beginning on this class of diseases has been made by Beyerinck and Woods in the study of the Mosaic disease of tobacco.

In the time which has passed, much attention has been given to the parasite and comparatively little to the host plant. The plant has seemed to many in the nature of a passive agent. This is far from being the true state of the case. In time to come I would not have the parasite studied less (it must be inquired of with still greater care, especially as to what are its limits in the use of foods, and in the toleration of non-foods), but I think that the host must also, certainly, be studied more diligently if the wonderful progress in plant pathology during the last two decades is to continue. To my mind, the problem of problems in pathology, both animal and vegetable, during the next fifty years will be the varying nature of the host plant or host animal as related to the parasite. This is the burning question. Why is it that some individuals are so very susceptible to disease and others so resistant? Why is it that the same organism is more susceptible at one age, or at one time or season, than at another? These are questions intimately connected with structure and with changes in secretion and excretion, *i. e.*, with the complex chemistry and physics of the individual body, and we shall never be able to solve the difficult problems of plant immunity and put our knowledge into practice for the prevention of diseases until we have a much more intimate acqaintance with the plant cell as a chemical laboratory, or as a physio-chemical laboratory, if you prefer that term. When we are able to point out clearly just what the chemical and physical changes have been

* Since this was written considerable light has been thrown on the subject by Mr. J. F. Clark (*Bot. Gaz.*, January, 1902, p. 26).

which lead up to susceptibility to a given disease, then we shall have gone a very long way toward pointing out to the practical man the methods by which he will be able to avoid bringing about those specific changes which end in disease. It is certainly entirely within the bounds of the possible to know definitely just what particular changes lead to disease, *i. e.*, tend to invite a given parasite, or a given degeneration, and, knowing these, to put the plant or animal under such conditions as to food, light, air, etc., as will lead to the development of counter changes tending to ward off disease. A beginning has already been made, but much remains to be done, and a more inviting field of research does not anywhere lie open to the young and earnest experimenter.

The so-called 'practical man' has gone about as far as he can go and must have help from the technical and laboratory man. Personally, the speaker has no sympathy with that line of thinking that would hold the pathologist to the narrowest kind of experimental or field work, or which requires him to make bricks without straw. Of course, I mean bulletins without new discoveries to put in them. Nothing is gained by repeated threshing of old straw, and time, the most precious of all things, is lost. Haphazard experimenting is not science. Every decade will not be fortunate enough to stumble on a Bordeaux mixture. The trained pathologist should be given plenty of time and the largest liberty, and allowed to work out his own salvation as best he can. This he must do very largely by experimental devices, and he certainly will never be able to get very far without a thorough technical training and use of the exact methods of the laboratory, or, as I have already pointed out, without chemical knowledge and much assistance from the chemist and physicist. I would not disparage field work. It is right as far as it goes, and I think every pathologist ought to have a thorough acquaintance with diseases as they occur in the field; but a man may work all his life in the field and never get beyond a rule of thumb, if he does not also have that technical training which is usually acquired only in the laboratory. The pathologist must be able to see all that the practical man sees, and a great deal more. In other words he must not only see that things go on in a certain way in the field, but he must also be able to probe beneath the surface and determine why. It is then, often, not difficult for him to make nature conform to some other and better plan whereby harvests are saved and the hungry are fed.

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*THE BIOLOGICAL BASIS OF LEGISLATION GOVERNING THE LOBSTER INDUSTRY.**

CAUSES OF THE DECLINE.

The causes of the growing scarcity and the yearly diminishing average size of the lobsters caught are: (1) *The natural demand,* arising from an increasing population. This increased demand has not been met by a correspondingly increased source of supply. (2) *The existing laws,* for the reason that the destruction of adults has been permitted. The present laws, with their practical difficulties of enforcement, have had an adequate trial. The decline of the lobster industry demonstrates that these laws have proved inefficient for increasing or even for maintaining the supply. The chief defect of the present laws seems to lie in permitting the destruction of adults.

SUGGESTIONS FOR REMEDIAL LEGISLATION.

Of the suggestions for legislation to check this decline, seven, either singly or in

* Abstract of a 'Report' to the Massachusetts Commissioners of Fisheries and Game, and published in their 'Annual Report' for 1901 (Public Document No. 25).

combination, appear to be especially prominent:—

1. A close season (*a*) for a portion of each year, or (*b*) for a term of years.

2. The continuance of the present 10½-inch law, under more effective enforcement.

3. The substitution of a 9-inch law.

4. The prohibition of the killing of egg-bearing lobsters.

5. The prohibition of the killing of any female lobsters.

6. The removal of all restrictions as to catching.

And finally, as an entirely new proposition, which I personally venture to advance,

7. The protection of all adult lobsters above the breeding age, and the removal of restrictions on the catching of the immature which are of satisfactory marketable size.

A just and adequate law which meets most requirements, wherever identical conditions obtain, will increase the chances of securing effective uniform legislation throughout the lobster-producing districts.

An impartial balancing of the merits and defects of the several propositions is here attempted:

1. *A Close Season.*—(*a*) For a portion of the year. A close season may bring manifest and satisfactory results in cases where the animal is a rapid breeder, or where the young reach maturity in a short time. But a close season is not equally applicable for checking the numerical decline of every, or any particular, animal. This is notably true of the lobster. A close season must fail to bring the expected results, for the reason that the lobster is a slow breeder, laying eggs but once in two years, and carrying these eggs, attached to the modified legs under the abdomen, for ten or eleven months after laying; while the young require probably from four to seven years to reach maturity and attain a length of seven to ten inches.

Finally, the fundamental defect of a close-season law is that it restricts the demand but does not adequately and economically increase the supply.

Aside from the practical difficulties of securing a uniform close season throughout the lobster range, and enforcing the laws, the value of the close season to the lobster as a race is commensurate with the duration of this close season. The longer it extends, the better for the lobster but the worse for man. The burden upon investments in the lobster fisheries is increased. The absence of the lobster from the human food supply is felt by the public. Yet all this is of little avail, for the effects of the close season are not permanent. The causes of the decline have not been removed. The lobsters, through a close season, either from one to six months each year, may have a chance to 'catch up,' only to be themselves 'caught up' with redoubled energy, resulting in a glutted market, and consequent economic waste for a time, with the certainty of a rapid return to the former conditions which made a close season necessary.

(*b*) Close season for a term of years. Most of the foregoing statements apply also to a close season for a term of years. The primary inherent defects in the close season are that it does not reach the cause of the decline, and it fails to recognize the fact that the lobster can and should be reckoned as a perennial and perpetual food for man. Human effort can so control conditions that the supply may be large or small. By taking proper measures the lobster supply can be made abundant and continuous, instead of intermittent.

2 and 3. *Continuance of Present Length Law or Substitution of Another.*—The 9-

and 10½-inch laws are the ones which have met widest favor. They are identical in inconvenience of application and in difficulty of enforcement.

Neither the 9-inch law in New York, the 9-inch and 'female lobster with spawn attached' in Connecticut, 9-inch and a closed season in Rhode Island, 10½-inch in Massachusetts, 10½-inch and 'female lobsters while carrying their spawn or hatching their young' in New Hampshire, 10½-inch since 1897 in Maine, nor the 10½-inch and a closed season from June 30 to January 14 in the Maritime Provinces, has prevented the continued rapid decline in (1) the number of lobsters caught, (2) the average size of the lobsters caught, (3) the average number of egg-bearing females reported, (4) the number of persons who can depend upon the fisheries for support, or (5) has checked the rapid rise in the price of lobster meat.

Further, these laws have been found by experience to be difficult of application and expensive in enforcement and alike disagreeable to officer and offender.

The sole apparent merit of this law seems to be that it does prevent the catching of some lobsters; just how many is dependent upon the honor of the fishermen and the means of enforcing the law. Its greatest defect, and from a scientific point of view an irreparable one, consists in the fact that it affords no protection to those lobsters which most need protection—the mature breeding individuals—but puts a premium on their capture through tacitly specifying that only adults above the breeding age shall be killed. What would be the effect upon our supply of poultry and eggs if a law should be made 'protecting' poultry under one year, or under a certain size or weight? It absolutely ignores the biological laws which man has found by experience to be of the utmost importance wherever it has become necessary to increase the natural food supply to meet the increasing population—the protection of the adult animal in order to secure a supply of young of that species.

4. *The Prohibition of the Killing of Egg-bearing Lobsters.*—To prohibit the killing of any egg-bearing lobsters is good legislation so far as it goes, but it is open to the objection that it pushes into prominence the temptation to comb off the eggs, and thus make the lobster a marketable one. It has practical difficulties of enforcement.

5. *The Prohibition of the Killing of any Female Lobsters.*—The prohibition of the killing of any female lobster would promise more effectiveness were it not for the fact that it involves catching, and a subsequent sorting and liberation.

6. *The Removal of all Restrictions as to Catching.*—The proposal to remove all restrictions as to catching lobsters must inevitably lead to the destruction of the industry, unless a sufficient artificial supply can be maintained to meet the demand, and thus far this seems impracticable. Certainly satisfactory results have not been reached in the case of the lobster, though further investigation and examination must yield far-reaching results.

7. *The Protection of All Adult Lobsters Above the Breeding Age, etc.*—The method of protecting all the adults, and catching only a portion of the young, promises very satisfactory results in the case of the lobster, for the reasons:

1. That the ratio of the biological, *i. e.*, reproductive, value increases very rapidly after the size of nine to ten inches has been reached, as shown by Professor Herrick's table.

2. The number of enemies diminishes very rapidly as the lobster increases in size.

SUGGESTIONS FOR NEW LEGISLATION.

The logical basis, then, for the law is:

1. Protect the adults. Catch only the small lobsters, not the large ones.

2. Protect enough of the young to ensure a sufficient number of adults.

3. Protect those below a size which experience has shown to be adapted for economic use, say six inches.

4. Use only a legal standard pot, having the opening of such size as to prevent the entrance of a lobster say above nine or ten inches, and with slats far enough apart and numerous enough to insure the escape of all lobsters less than six inches. Fix a date when all pots shall conform to the standard.

5. Penalize the possession or sale of lobsters above ten inches and below six inches, and of pots not conforming to the legal standard.

6. Establish a State committee, to cooperate with similar committees from the other lobster-producing States and the British maritime provinces, for considering the advantages and possibilities of uniform lobster laws, for coordinated investigations of the important economic facts in the natural history of the lobster, and for devising improved methods of artificial lobster culture. Rhode Island is obtaining very valuable and practical results on some important phases of the question under the direction of Professor Mead.

The chief apparent objections are:

1. That such a proposal as has been outlined is too radical, too great a departure from precedents and from the laws in force in other States. To this it may be answered that the existing lobster laws have little common-sense foundation; they have been based upon misconceptions, and often, no doubt, upon ignorance and local politics; they are directly contrary to scientific experience, and the continued decline of the lobster industry has proved them to be ineffective for the purposes for which they were instituted. They are based neither upon the laws of human economy nor upon the natural history of the lobster.

2. It has been claimed that 'such laws as those proposed would lead to the capture of all the lobsters.' At first an actually greater number of lobsters would undoubtedly come into the market; but the increased number of individuals killed would not result in such an increased weight as to materially affect market conditions, and the productive capacity of the protected individuals would be expected to more than offset the apparent loss from the marketing of immature individuals. In other words, the actual value of one above ten inches long in potential productive capacity is many times that of one between six and ten inches long, and man could use as food a larger number of six-inch lobsters without doing the biological damage which results from the killing of a single lobster of from nine to eleven inches long, and at the same time have an actually greater weight of lobster meat. If it is feared that under this proposal the lobster does not get sufficient protection, make the limit still narrower, say from between eight or nine inches to six inches.

1. Such a law would be relatively easy of enforcement, through the inspection of lobster pots.

2. It would work a minimum injury to vested interests, since sufficient time can be given to make all pots conform to the standard.

3. It does not remove the lobster from the market, and so does not interfere with the immediate or future interests of fishermen, dealers and consumers.

4. By protecting those lobsters which are of greatest biological value the interference

with the natural laws of increase is minimized.

5. It furnishes a basis for uniform legislation throughout the lobster-producing section. Being based upon common sense, and in close conformity with the natural history of the lobster and with human scientific experience with food supplies, it commends itself to fishermen and others who know human nature and the lobster in a practical way.

Finally, the proposed law, while fundamentally scientific, is eventually a compromise measure and combines the advantages (1) of a close season throughout the year for a part of the lobsters (*i. e.*, for those productive adults above a size to be agreed upon), and (2) of the size limit, thus meeting the wishes of the believers in both the 10½- and 9-inch laws. It seems to promise effectiveness in meeting existing conditions and in checking the decline. It is adapted for ready enforcement without resort to methods distasteful to officers and people, and at a minimum expense to the state.

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C. F. von Herrmann, Section Director, Weather Bureau, Raleigh, N. C.

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Coleman B. Waller, Vanderbilt University, Nashville, Tenn.

John Abbet Walls, 750 Main Street, Niagara Falls, N. Y.

John Daniel Walters, Professor of Industrial Art, Agricultural College, Manhattan, Kansas.

Frederic S. Webster, Carnegie Museum, Pittsburg, Pa.

Edgar A. Weimer, Mechanical and Blast Furnace Engineer, Lebanon, Pa.

Francis Ralston Welsh, 328 Chestnut Street, Philadelphia, Pa.

Francis W. Wenner, Superintendent of Public Schools, North Baltimore, Ohio.

Thomas S. West, Mechanical Engineer, Sharpville, Pa.

Lewis Gardner Westgate, Professor of Geology, Ohio Wesleyan University, Delaware, Ohio.

Henry Herman Westinghouse, Wilmerding, Pa.

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Miss Rosa L. Woodberry, Teacher of Natural Science, Lucy Cobb Institute, Athens, Ga.

Fred A. Woods, M.D., Harvard Medical School, Boston, Mass.

J. S. Wooten, M.D., Austin, Texas.

Benjamin F. Yanney, Professor of Mathematics and Astronomy, Mt. Union College, Alliance, Ohio.

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SCIENTIFIC BOOKS.

Regeneration. By Thomas Hunt Morgan, Ph.D., Professor of Biology in Bryn Mawr College. Columbia University Biological Series, Vol. VII. New York, The Macmillan Company. 1901. Pp. xii+316; 67 text figures. Price, $3.

The high character of the Columbia University Biological Series is more than maintained by its latest publication—Professor Morgan's book on 'Regeneration.' It is rare indeed to find a book which contains so large an amount of research work and which is at the same time of such general interest and importance. This is no mere description of the peculiar and bizarre 'dime museum experiments' of experimental zoology, but rather a thorough treatise on some of the most important methods and results of the new morphology.

To those who can read the signs of the times it is most evident that zoology has been passing through a period of revolution during the past ten years. A strong reaction has set in against the extremely speculative theories as to the factors of evolution, the inheritance or non-inheritance of acquired characters, and the whole 'phylogeny business' of a dozen years ago. The present attitude of most zoologists is more critical, less argumentative and in all respects more wholesome than prevailed when sky-scraping theories were erected on a single square foot of fact. In this wholesome reaction experimental morphology has played a most important part; in fact, it was the attempt to make biology an experimental science which first aroused interest in this subject, and while at times some of these experimental morphologists have illustrated the uncritical methods which they have denounced, while their conclusions have often been open to the criticism of having been hasty and ephemeral, no one can deny the fact that their work has introduced a new spirit into the study of zoology.

In this work the author has been one of the most productive and at the same time one of the most careful investigators. He saw, as apparently few others did, that the development of fragments of eggs and embryos was at bottom the same problem as the regeneration of parts of adult organisms, and during the past ten years he and his pupils have done a surprising amount of work on the regeneration of embryos and adults. There is probably no other living man so well fitted to treat this subject. To almost every topic discussed in the book, save the ones on regeneration in plants and on hypertrophy and atrophy, the author has made important original contributions. The literature list at the end of the book, which is very complete, covering the most important papers on regeneration from the time of Aristotle to the present day, includes 470 titles, and one tenth of this total list has been contributed by Morgan and his pupils. As a result the discussion of each topic evinces a thoroughness of treatment and a ripeness of judgment which could come only from long and intimate acquaintance with the problems involved. The book is therefore not merely a summary of the work which has been done on regeneration, but it is also a splendid contribution to knowledge.

In the fourteen chapters of the book the following subjects are presented: An historical and general introduction, the external and internal factors of regeneration in animals, regeneration in plants, a discussion of the supposed relation between regeneration and liability to injury, regeneration of internal organs, physiological regeneration, fission, budding and autotomy, grafting, origin of new cells and tissues, regeneration in egg and embryo, theories of development and of regeneration, general considerations on organization, vitalism and teleology. Of these topics the ones on regeneration and liability to injury, regeneration in egg and embryo, theories of regeneration and of development and the general considerations are of most general interest.

The greater part of the chapter on regeneration and liability to injury has already appeared in SCIENCE, and it need only be said here that Morgan has established in the most convincing manner the fact that there is no causal relation between the two, and that therefore it is impossible to regard the wonderful adaptations of regeneration as a result of the action of natural selection. It has long been recognized that natural selection is not so much a theory of evolution as an attempt to explain on causal grounds the remarkable and exquisite adaptations shown by living things. Nowhere are such adaptations more striking than in regeneration, and yet here it is in some cases quite certain that such adaptations cannot be attributed to the action of the Darwinian or of the Lamarckian principle. All theories which attempt to explain adaptations hold that they are due to experience; Lamarckism, that they are the direct result of use, disuse and need; Darwinism, that they are the indirect result of experience through the survival of the fittest. No theory yet advanced can explain adaptations to conditions never experienced before, and yet in the regeneration of animals there are adaptations which are undoubtedly of this sort. The

credit of first having shown the inability of natural selection to explain certain cases of regenerative adaptation belongs to Gustav Wolff rather than to Morgan, but the latter has greatly enlarged and extended the evidence in favor of this position. Nevertheless the author is conservative in his treatment of this question; he launches into no 'railing accusations' against natural selection, but is content to point out its insufficiency in the cases under discussion, wisely leaving others to draw their own conclusions as to its general applicability.

Likewise in his treatment of the theories of development and regeneration the author shows a wise conservatism which is in refreshing contrast to some of the revolutionary assertions of the earlier stages of *Entwicklungsmechanik*. The author's conclusion that regeneration and development belong to the same general group of phenomena and that the same problems are met with in the two is a most important and valuable one. His present position that the development of egg fragments is only a special case of regeneration plus the phenomena of development is fundamentally like the view expressed earlier by Roux ('93) and unlike the position which Driesch and Morgan formerly maintained. Thus he says (p. 247): "We have, however, no reason to suppose that all the (cleavage) cells are alike because they are all potentially equal. Even pieces of an adult animal—of hydra or of stentor, for example—can produce new whole organisms, although we must suppose these pieces to be at first as unlike as are the parts of the body from which they arise. Moreover we do not know of a single egg or embryo in which we cannot readily detect differences in different parts of the protoplasm." Contrast this with Driesch's famous dictum, 'By segmentation perfectly homogeneous parts are formed capable of any fate,' or with Morgan's former statement that 'the micromeres (of the sea-urchin egg) are undifferentiated blastomeres, and are not set aside to form any special organ, because normal embryos still come from such fragments without micromeres.'

The author finds the great problems of development and regeneration centering in the determination of the causes of differentiation and these causes he finds in the organization. What this organization is, however, cannot be explained any more than the physicist can explain what gravity is. The author does not conceive this organization to be the outcome of the integration of biophores or other 'vital units,' nor can it be identified with cells. "Just as the properties of sugar are peculiar to the molecule and cannot be accounted for as the sum total of the properties of the atoms of carbon, hydrogen and oxygen of which the molecule is made up, so the properties of the organism are connected with its whole organization and are not simply those of its individual cells or lower units." The smallest pieces of organisms capable of regeneration are enormously larger than individual cells, and therefore 'the organization is a comparatively large structure.' It seems to me that in this matter the author loses sight of the fact that organization like individuality is a thing of degrees and stages. There is undoubtedly such a thing as the cell organization and this is capable of performing certain functions; whether or not it is able to perform the function of regeneration depends upon the animal in question. In protozoa and the egg cells of metazoa it is capable of regeneration as well as of all other functions; in adult metazoa regeneration can be accomplished only by pieces larger than cells, *i. e.*, by an organization of a higher order than that of the cell.

In connection with the question of organization the author makes the pregnant suggestion that it may consist in a system of tensions in the living substance rather than in the polarity or other properties of ultimate units. Such a view would accord well with the facts of regeneration and while 'we cannot picture to ourselves in a mechanical way just how such a system could bring about the suppression of growth in one region and allow the maximum amount in another region,' it not only accords well with the facts but brings a large number of phenomena under a common point of view.

However attractive neo-vitalism may be for

others, it has no peculiar charms for the author who refuses to be stampeded by the apparently intelligent and purposive adaptations of organisms to conditions never experienced before or by the 'proportionate formation of parts' in regenerating embryos and adults. Such phenomena, he thinks, "may be entirely beyond the scope of legitimate explanation, just as are many physical and chemical phenomena themselves, even those of the simplest sort. * * * Even in the physical sciences it would not be difficult to establish a vitalistic principle, or whatever else it might be called, if we choose to take into account such properties as the affinities of atoms and molecules, etc. * * * For my part I see no grounds for accepting a vitalistic principle that is not a physico-causal one, but perhaps a different one from any known at present to chemistry and physics."

Finally, if the adaptations shown in regeneration cannot be explained by natural selection are they to be explained by some teleological principle? To this question the author attempts no direct answer. It is pointed out that not all forms of regeneration are adaptive, *i. e.*, useful, and that 'unless we suppose that some external agent, acting as we do ourselves, directs the formative processes in animals and plants, we are not justified in extending our experience as directive agents to the construction of the organic world.'

These brief extracts do not do justice to the author's argument, but they serve to show his general position on these important questions. The book will undoubtedly take a prominent place among the standard biological works of the world.

E. G. C.

Die Farngattung Niphobolus. By Professor GIESENHAGEN. Jena, Gustav Fischer. 1901. 8vo. Pp. xii + 223. Price, Mk. 5.50.

For a clean piece of monographic work the ideal conditions are a genus of plants of moderate size whose distribution is somewhat circumscribed, and with sufficient adaptability to environment to have induced striking structural characters among the species. Such a condition is represented in the present genus. To monograph such a genus one needs, in addition to library and herbarium facilities, to be possessed of a good knowledge of technique and above all to know the plants in the field. Such a knowledge of this genus Professor Giesenhagen gained in his travels in Sumatra and other portions of the East Indies and the result is a clearly written monograph of the fifty species of the genus.

The genus forms a rather natural group of ferns which has commonly been included under the genus *Polypodium,* and is easily recognized by the vestiture of star-like hairs covering the laminæ. The center of distribution appears to be in India and South China where nearly one half the species (21) are found. Westward the genus extends to Africa (two species), northward to Japan (three species), eastward to Taiti (one species), and southward to Australia (two species). Endemic species are known from most of the larger islands of this region, as Bourbon (one), Ceylon (three), Sumatra (one), Philippines (three), Java (two), Celebes (two) and Borneo (one). One or two species are well known in cultivation under the name *Polypodium Lingua.*

Sixty-five pages of the monograph are devoted to the morphology of the genus and the details of stem and leaf anatomy are clearly brought out, as are the modifications resulting from habitat and environment. This portion of the work is illustrated by a well-selected series of text figures illustrating structures comparatively, which is the only satisfactory method for a work of this sort. The descriptive portions are very clearly and fully made, an entire paragraph being given to anatomical details under each species—a valuable and noteworthy addition to ordinary taxonomic description. The English methods in taxonomy are frequently commented upon with no uncertain sound, being characterized as a classification with 'hands and eies only' (*sic*) by which they group together widely different species. The work of the English systematists who have hitherto recognized only twenty-three species in this group, is sharply contrasted with the careful work of Mettenius and Kunze in Germany. The author, how-

ever, forgets to note one feature of German taxonomic methods altogether too common in recent monographic work in his own country, and one that more than once has led him into minor errors that could easily have been avoided. In preparing his monograph, Giesenhagen had access to a loan for a short time of the herbarium materials from Berlin, which is unquestionably the finest Continental collection, and also had access to the types of Blume's Javan ferns from the Museum at Leyden, but the richest collection of all in this and every other genus of ferns, namely, that at Kew, England, the author never consulted. In fact, German monographers rarely consult this magnificent collection, and as a consequence of this neglect, go on producing monographs which contain either avoidable errors or lamentable omissions. To cite an instance from the present case, the English botanists had confused a common Indian fern with one of Blume's Javan species, of course without having seen Blume's plant, for English botanists do not always take the trouble to gather evidence if it involves crossing the English Channel to get it. Our present author, after an examination of Blume's type finds the Indian plant something very different, as might have been expected, and in spite of the fact that the Indian plant already had been named independently by other English botanists commencing with Wallich, proceeds at once to name it '*Niphobolus Mannii* n. sp.' This is surely an economical method of procedure—in fact saves the time and money necessary to visit Kew—but as a question of ethics or scientific accuracy it is not to be commended in a formal monograph. Wallich's name must hold for this plant unless there should prove to be an earlier one.

In short the principal criticisms that can be offered to the work in hand are those that bear on the lack of accuracy in citation and nomenclature and yet these imperfections mar an otherwise admirable volume. In citing specimens examined the author often uses an entire page and sometimes two pages in needlessly quoting the entire label from the herbarium sheet—data important in their proper place, but in even the more extended series here given capable of being condensed and better classified into ten lines in so far as they give information respecting geographic distribution. On the other hand *icones* are rarely cited and in some cases the reader is in doubt both as to the original author of the species described and its type locality. Last of all the name *Niphobolus* is itself untenable. The author, working under the old conception that a genus is a description or a definition instead of a group of related species, passes over Desvaux's genus *Cyclophorus* (1811) because neither in his generic description nor in those of its six species which the present author admits 'alle echte *Niphoboli* sint' does Desvaux mention the peculiar vestiture which characterizes the members as now understood. Because of this and because Kaulfuss in 1824 had substituted *Niphobolus* for *Cyclophorus,* since the latter name had been used for a genus of shells, our present author unfortunately uses the latter name, which in the rational and progressive system now in use in biological nomenclature cannot stand. It is unfortunate that so complete a monograph should be lacking in the minor essentials of modern scientific accuracy.

Lucien M. Underwood.

The Practical Methods of Organic Chemistry. By Ludwig Gattermann, Ph.D., Professor in the University of Freiburg. With numerous illustrations. Translated by William B. Schober, Ph.D., Instructor in Organic Chemistry in Lehigh University. Authorized translation. The second American from the fourth German edition. New York, The Macmillan Company. 1901. Pp. 359.

Gattermann's book is favorably known in organic laboratories. It consists of a brief general part dealing with analytical operations and laboratory methods, and a special part of organic preparations. To quote, 'To each preparation are added general observations which relate to the character and general significance of the reaction carried out in practice.' This feature is a very great help to the student.

This edition includes a number of new prep-

arations. It has been well translated by Dr. Schober, and is clearly illustrated.

E. RENOUF.

Laboratory Exercises in General Chemistry. Compiled from various sources by G. W. SHAW, A.M., formerly Professor of Chemistry at Oregon State Agricultural College. For use in connection with Storer and Lindsay's 'Manual of Chemistry.' New York, American Book Company. Pp. 63.

This book is better than most of its class. A generally valid objection to the use of laboratory books instead of the text-book is that they enable a student to perform an experiment without thought of the principle which it illustrates. Such objection cannot be made to this book, for each exercise contains many questions requiring verbal answer to the instructor or written answer in the laboratory note-book.

E. RENOUF.

The Elements of Qualitative Analysis. By WM. A. NOYES, Ph.D., Professor of Chemistry in the Rose Polytechnic Institute. Fifth edition, revised. New York, Henry Holt & Company. 1901. Pp. 101.

In this new edition of his excellent and well-known manual, Professor Noyes introduces and expands the method of Abegg and Herz for the systematic detection of acids. He divides the acids into eight groups, using as reagent for group 1 concentrated sulphuric acid; for groups 2, 3 and 4 calcium chloride, barium chloride and zinc chloride respectively in neutral solution; for group 5, color reaction with ferric chloride; group 6, silver nitrate; group 7 contains the acids whose calcium, barium, zinc and silver salts are soluble; and group 8, the commoner organic acids which carbonize on heating. This method seems simple and little open to error.

E. RENOUF.

SOCIETIES AND ACADEMIES.

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE eleventh regular semi-annual meeting of the Section was held at the University of Chicago, on Saturday, March 29, the first session opening at 10 o'clock A.M. At the morning session Professor Townsend, of the University of Illinois, and at the afternoon session Professor Moore, President of the Society, occupied the chair. The following papers were read:

Morning Session.

Nachtrag zum Artikel: 'Zur Erklärung der Bogenlänge,' u. s. w.: Professor O. STOLTZ, Innsbruck, Austria.

'The Mutual Independence of Hilbert's Axioms within the Various Groups': Mr. ARTHUR T. BELL, University of Illinois.

'On the Superosculation of Surfaces': Professor H. MASCHKE, University of Chicago.

'A Certain Conic connected with the Isotomic Relation': Professor LAENAS G. WELD, University of Iowa.

'Concerning the Second Variation in the Isoperimetric Problem': Professor O. BOLZA, University of Chicago.

'Concerning the Isoperimetric Problem on a Given Surface': Professor BOLZA.

Afternoon Session.

'Some Remarkable Cases of Libration among the Small Planets of the Hilda Type': Professor KURT LAVES, University of Chicago.

'On the Interchange of the Order of Differentiation': Professor E. J. TOWNSEND, University of Illinois.

'On the Group Defined for Any Given Field by the Multiplication Table of Any Given Finite Group': Professor L. E. DICKSON, University of Chicago.

'Theorems on the Residues of Multinomial Coefficients with respect to a Prime Modulus': Professor DICKSON.

The committee appointed at the last meeting of the Section to consider and report a scheme of equivalent requirements for the Master's degree, for candidates making mathematics their major subject, presented a preliminary report which was discussed and ordered to be manifolded for distribution among the members of the Society. The report is in the hands of the secretary of the Section and a copy will be sent to any members applying for it.

THOMAS F. HOLGATE,
Secretary for the Section.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF BIOLOGY.

At a regular meeting of the Section on March 10, the following program was offered:

'The Four Phyla of Titanotheres': Henry F. Osborn.

'The Early Development of Sharks from a Comparative Standpoint': Bashford Dean.

'The Cytological Phenomena of Maturation and First Cleavage in the Cirriped Egg': Maurice A. Bigelow.

'The Effect of the Wind on Bird Migration': C. C. Trowbridge.

Professor Osborn presented some results recently obtained for a U. S. Geological Survey Monograph. The Lower Oligocene Titanotheres prove to belong to four distinct phyla, to which the prior generic names *Titanotherium, Symborodon, Megacerops* and *Brontotherium* may be applied. The chief distinctions are found to be in the dolichocephalic or brachycephalic form of the skull, in the shape, length, position and mechanical relations of the horns, and in the number and form of the incisor and canine teeth. Each genus obviously had distinctive modes of fighting, locomotion and feeding. *Titanotherium* extends from the base to the summit of the Lower Oligocene. It is distinguished by its long narrow skull, short horns, powerful canines, vestigial incisors. *Megacerops,* on the contrary, is broad-skulled, short-horned, with obtuse canines, and with at least one upper incisor. *Symborodon* is distinguished by the narrowing of the anterior portion of the premaxillaries, reduction of all the anterior teeth, and by elongate horns placed immediately over the eyes. In *Brontotherium,* the horns are by far the largest and most powerful, and acquire an extreme anterior position, absorbing the free portion of the nasals; all the upper cutting teeth persist; great buccal plates are evolved; and the skull measured along the base line is extremely brachycephalic. The four types were illustrated by models and diagrams.

Professor Bashford Dean considered briefly some points in the development of sharks, and attempted to reduce the type of the early development of the recent types to that of their holoblastic ancestor. This form probably occurred within the strict limits of the group Elasmobranchii—for the absence of clasping organs in the palæozoic genera of Acanthodians and Cladoselachids predicates external fertilization, and eggs many in number and of small size. In the line of this comparison, reference was made to the early development of the Japanese 'pavement-toothed' shark, *Cestracion japonicus,* in which, as the author showed in a recent number of the 'Annotationes Zoologicæ,' surface furrows are present, traversing the yolk, and are best interpretable as reminiscent of holoblastic cleavage. In the peculiar type of early development in *Chimæra,* total cleavage is suppressed until about the time of gastrulation, when cleavage furrows appear in the region of the lower pole and come to divide the egg into a number of distinct blastomeres, only one mass of which, however, become enclosed in the yolk-sac of the embryo. The remaining blastomeres, by a process of continued division, provided nutriment for the embryo *via* gills and gut. Dr. Dean announced the presence in *Chimæra* of a true archenteric invagination, occurring early and at some distance from the margin of the blastoderm. It is small in size, and has a distinct cellular floor. Its (anterior) dorsal wall was compared to the dorsal lip of the archenteron of sharks, as described by Rückert and others. The ventral wall of the archenteron of modern types of sharks has thus lost its cellular character during the process by which the embryo acquired a more perfect and specialized (cænogenetic) mode of obtaining nourishment from the yolk.

The paper by Dr. Bigelow dealt chiefly with protoplasmic movements and associated displacements of the yolk materials in various cirripede eggs during maturation and first cleavage. The telolecithal distribution of the egg substances, the formation and disappearance of a yolk-lobe, and precleavage movements associated with differential distribution of the entoblastic materials were described. Finally, a turning of the first cleavage spindle from a transverse to an oblique axis of the ellipsoidal egg was compared with similar more extensive movements in nematode eggs.

Mr. C. C. Trowbridge presented the results of systematic observations on the effect of the wind on the migration of hawks and many other birds along the Atlantic coast. The principal points of the paper were illustrated by means of diagrams giving the directions taken by the migrating birds under the influence of different winds. It was shown that a knowledge of meteorology was necessary in considering this subject, because the effective winds depend on storm centers traveling eastward. In one case, in the height of the southward migration, a storm center off the coast of Maine caused northerly winds throughout 800,000 square miles in the eastern part of the United States and Canada, the velocity of the wind area averaging twenty miles per hour. A former paper on the subject was briefly reviewed, in which the author showed that flights of hawks and other land birds during the migrations were due to the crowding of the birds in a narrow coastline path by the wind. The recent observations now warrant the conclusion that hawks and many other birds regularly depend on a favorable wind as a help in their migratory movements, and, as a rule, migrate only when favorable winds occur. A brief account was given also of a retrograde movement of migrating swallows in the spring, evidently due to a return flight of the birds after they had been blown far out of their course by a strong wind from the west.

HENRY E. CRAMPTON,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

A MEETING was held on March 28, Professor Farrand in the chair. The present sectional officers were reelected for the ensuing year.

Dr. Clark Wissler reported on the growth of boys. The annual physical measurements of some three hundred schoolboys were correlated to discover tendencies and directions of growth. It appeared from the data that growth was rather uniform, as for example, when a boy's legs were growing rapidly his arms were also growing at a corresponding rate. By correlating the stature with its increment for the following year it was seen that the sign of correlation changes when the pubertial maximum of growth is crossed. This means that boys who are growing rapidly at twelve, for example, continue to grow rapidly until fourteen or fifteen, when they slow down, while those growing slowly before this period now grow rapidly. Thus it appears that the point of pubertial maximum rate of growth, as determined by mass measurements, is really the point dividing the boys who mature early from those who mature late. The relation is yet more in evidence when the annual increments are correlated without regarding the absolute measurements. The results as a whole seem to show that the rate of growth in any particular year is of no special significance except as an index of the relative maturity of the individuals concerned.

Mr. W. S. Kahnweiler reported on a trip that he made last summer through French Indo-China to the Angkor Wat. His paper was illustrated with lantern views of the trip, and of the architecture and sculpture of the ancient temple. The history of the temple was briefly outlined.

R. S. WOODWORTH,
Secretary.

TORREY BOTANICAL CLUB.

AT the meeting of the Club on March 11, 1902, the first paper, by Edward S. Burgess, was on 'Plant Illustration in the Middle Ages,' being a portion of a contribution to the history of early botany soon to be printed among his 'Aster Studies.' The paper was illustrated by examples from his library, of early woodcuts intended to represent *Aster,* dated 1485, 1499, etc. (long anterior to the first adequate drawing of *Aster,* that of Fuchs in 1542); also examples of the value once put upon the vellum used for manuscripts, showing an Italian manuscript dating perhaps from before 1200, in which torn vellum had been carefully mended before writing. He also exhibited a series of heliotypes representing about twenty-five pages of unpublished mediæval manuscript containing drawings of plants, and nearly as many pages more of decorated text, photographed by Professor

Giacosa, of Turin, to accompany his recent edition of certain of the Salernitan masters ('Magistri Salernitani,' Turin, 1901).

Early plant drawings give their chief attention to outline; particularly of leaves, stem and branches. Flowers were less often and less successfully indicated. The characteristic *habit* of a plant, however, was often caught very perfectly. Figures were copied often with scrupulous care from one manuscript to another. Several causes tended, however, to their degeneration. Pliny charges the blame for the imperfect plant-figures of his time upon lack of skill of copyists. Some of the worst among later errors were those of copyists who had never seen the plant and who were attempting copies of plants of distant regions as in early Anglo-Saxon figures of *Aster* and other classic plants. In other copyists a desire for balance and symmetry overcame their fidelity to the original, so that they conventionalized their plants; as seen strongly in later Italian work exhibited, developed in the fourteenth century from the Salernitan school; and as retained in early printing, Italian woodcuts of 1499 inheriting the same tendency. A fourth source of error in plant-figures was the mediæval love of the marvellous, so that many copyists outdid their text in depicting fictitious monstrosities, as in the fifteenth century pictures of mandrakes, Tartarian lamb, etc.

Some of the earliest plant-figures of which we know were those made by Cratevas, Greek physician to Mithridates, about 100 B.C. Something of their character and form probably still survives to us in certain illustrated manuscripts of Dioscorides, of the fifth century, with figures evidently copied, not from each other, but from an earlier common source. There is great need in the interests of the history of botany, that the project of publishing the figures of the Anician Vienna codex, now laid aside for nearly two centuries, should be revived and carried to successful issue. In the discussion following this paper Dr. Britton, Dr. Underwood, Professor Lloyd and Mr. Eugene Smith participated.

The second paper was by Mr. W. A. Cannon, entitled 'Observations on the Structure of the Ovular Integuments of *Dichelostemma capitatum*.' Colored figures were shown, indicating the final absorption of the inner integument by the developing endosperm. The haustoria of the mistletoe penetrate the oak cortex by secreting a ferment which dissolves the neighboring cell walls; excepting certain lignified cells which become incorporated in the haustoria. So also in this liliaceous plant, better known to many as *Brodiæa*, the haustorial enzyme is unable to dissolve the cuticularized membrane of the integument. Possibly such cases of absorption of non-dissolved cuticularized membrane may be widespread.

Professor Lloyd in discussion suggested that different parts of the ovule may be able to secrete different kinds of enzymes, ready to attack different kinds of tissues simultaneously; at least three different enzymes have been obtained by mechanical means from the yeast-plant. In certain of the Rubiaceæ the formation of enzymes in the megaspore antedates fertilization; and that the pollen-tube develops an enzyme is well known.

The final contribution of the evening was by Dr. N. L. Britton on the 'Morphology of the flower of *Dichondra*,' a plant commonly assigned to the Convolvulaceæ. Its little rotate flowers resemble a saxifrage and are highly incongruous with the Convolvulaceæ.

Edward S. Burgess,
Secretary.

Northeastern Section of the American Chemical Society.

The regular monthly meeting of the Section was held on Wednesday, March 26. Professor H. W. Conn, of Wesleyan University, presented an interesting paper on 'Some Aspects of Commercial Bacteriology.' The early history of the use of butter cultures in Denmark was reviewed, and the successful use of the cultures in that country was attributed to the law passed by the government requiring all cream used in making butter to be Pasteurized. This produces a mild butter with the flavor characteristic of the pure culture used. In this country such a mild butter has not met with ready sale, and if the cream has been

Pasteurized, it is possible to produce only a mild butter. In order to procure the more pronounced flavor as desired here, the cream is allowed to ripen and a 'starter' removed for the following day. In this way butter having a characteristic flavor may be produced without the use of a pure culture. Professor Conn believed that the ripening of cream takes place in two stages; the first being the rapid growth of certain albumen-destroying bacteria; and the second, the rapid growth of lactic-acid-producing bacteria. In completely ripened cream the latter only are present and constitute the pure Danish cultures which give mild butter. The former seem to be the cause of the stronger flavor desired in America. They do not affect the flavor of the Danish butter, as they are all destroyed in the process of Pasteurization. It is interesting to note that pure cultures are used in this country to a greater extent by the producers of oleomargarine and 'process' butter than by the dairymen.

The second paper of the evening was read by Mr. S. C. Prescott, of the Massachusetts Institute of Technology, who gave an interesting review of 'The Nature of Enzyme Reactions.'

HENRY FAY,
Secretary.

ONONDAGA ACADEMY OF SCIENCE.

THE 54th regular meeting of the Academy was held in the Historical Rooms, March 21, 1902.

Dr. Charles W. Hargitt spoke on 'Bird Migrations and Food Habits,' emphasizing the remarkable exactness in time with which certain of the birds annually arrive. The time, manner and causes of migrations were fully discussed. In speaking of the 'Food Habits' of birds, Dr. Hargitt pleaded for a fair balancing of the results found in the analyses of the stomach contents, as a single berry *vs.* the harmful insects destroyed, and accentuated the importance of avoiding prejudices.

Professor G. A. Bailey spoke of the 'Traits of Birds,' mentioning the cowbird as a case of degeneration. It was gradually giving up nest-building and becoming more slovenly, as was also true for the American cuckoo. He also spoke of the difference in the shape of birds' eggs and suggested that it was due largely to differences in the kind of nests.

P. F. SCHNEIDER.

SYRACUSE, N. Y.

THE NEW YORK ASSOCIATION OF BIOLOGY TEACHERS.

THE second regular meeting of the Association for 1902 was held in the Board of Education building, on Friday evening, April 4. There was a general discussion on the subject of 'Field Work,' introduced by Miss Kate Burnett Hixon and Miss Mary D. Womack.

G. W. HUNTER, JR.,
Secretary.

DISCUSSION AND CORRESPONDENCE.

AN AMERICAN JOURNAL OF PHYSICS.

I AM not aware whether any discussion has been published, but it must have been keenly felt by everybody associated with the physical sciences, at least, that one of the important issues in the near future is the systematization and consolidation of the journals of American science. It seems to me that what we need is a clearing house or, better, a trust of American research literature, and the pooling in the present instance will be all the more justifiable as it will be nearly pure altruism. Few of the higher order of journals—I mean those which offer non-popular scientific articles—really pay. Many of them are conducted at a loss. Perhaps for this very reason some plan of amalgamation may be feasible.

In physics the conditions* are in every way deplorable. Much, perhaps most, of our best work goes out of the country, with the result that American journals, being in a sense superfluous to the foreigner, are but little read abroad. I have no statistics; what I state are merely the convictions of more or less desultory observations; but I am afraid they are even regarded with just a little superciliousness at home.

*Much to the same effect might be said of chemical and of geological journals, though I naturally shrink from it.

There is some reason for this state of things. If we were brutally frank we might agree that a man with us is hardly eminent until he has been acknowledged as an intellectual commodity in some foreign market. From some points of view this self-distrust and lack of independent judgment is laudable; but there is also a *habit* acquired in such things that is pernicious. It is not so long ago that the Germans went tuft-hunting in France, a custom from which they awoke one day in consternation. They have not gone there since. The question to consider is whether it is not now high time for us, in turn, to awake to a spirit of scientific patriotism. One does not have to read many books to learn with what enthusiasm an Englishman, a Frenchman or a German refers to the real intellectual accomplishments of his countrymen. Is there such pride among us? I doubt it. There is rather a tendency to exhaust all other bibliography first.

Somebody has wisely said that for the English-speaking race there is but one aristocracy, and that it has taken the vigor of England to found it. Certainly the daughters of our millionaires offer much convincing if not eloquent testimony. In a somewhat similar sense, it seems to me that the aristocracy of American scientists also resides in England, though one cannot deny that the continent has some fascination. Our efficient scientific men are apt to outgrow the American Association first, then they outgrow the National Academy, and finally the country itself is altogether too small for them. Their voices reach us in this final stage, harmoniously blended, from across the water. It is all very nice as a well-devised scheme of gradation, but where is the spirit of patriotism in all this? Can we ever hope to reach intellectual maturity in the eyes of the world if we belittle the dignity of our own institutions? Self-confessed incompetency may be a virtue, but one should at least first be sure that the incompetency really exists. If Europe were to close its gates systematically to American scientific research, I believe that no greater blessing could befall us. There is enough good work done here, that if it were only properly centralized and presented in bulk, it would command the attention of the world. We should then have on our own shores what we now so frequently run for abroad.

The urgent desirability of an attempt at centralization is precisely the point which I want to accentuate. In physics we now have two prominent journals, one of them old and widely distributed, but covering a scope much beyond physics. Its contributors are naturally the older conservative physicists of the country. Recently the desirability of a journal devoted to physics alone was responded to, and a thriving magazine now exists among us, whose contributors are, as a rule, the energetic younger physicists of the country. Between the two journals, I fear, there will be an inevitable breach, for no man who has materially contributed to the older journal will be willing to see that magazine go down, and with it the accessibility of the bulk of his own work.

I mention this now, since with the advent of the Carnegie Institution there will be, almost unavoidably, another center of vigorous publication in physics. I say unavoidably at a venture, for I am quite ignorant as to any plans in that direction. There would then be further divergence, and oh, the pity of it! If, however, it should be in some way possible to unite the two existing journals,* with the consent of all interested and at their instigation, into a single *American Journal of Physics*, under the auspices of the institution, I believe that the greatest good would thereby accrue to the country. It is the national, apart from the sectional, spirit which I am anxious to see fostered. I do not know how the editors of these journals may look on such a scheme. They are my friends, though they may be shaking their fists at me now; but I am innocent of guile. If through the Carnegie Institution we could get an *American Journal of Physics*, continuous with the physical part of the *American Journal of Science* and of the *Physical Review*, definitely established, and if every

* I do not refer, of course, to journals with a unique purpose like SCIENCE, or the *Astrophysical Journal*, or *Terrestrial Magnetism*, or the Circulars of universities, etc. It is the overlapping of journals of the same kind that I have wholly in mind.

American physicist, including those who are either ashamed of their birthright, or of so vast a stature and cast in such an heroic mould that they must seek their compeers abroad—if all American physicists were to unite to publish in a national journal only, I believe the result would mark an epoch in the history of the importance of American contributions to physics.

CARL BARUS.
BROWN UNIVERSITY,
PROVIDENCE, R. I.

THE CENTENARY OF HUGH MILLER.

ON the 10th of October, 1802, Hugh Miller was born at Cromarty, Scotland.

The folk of that picturesque town, whose surroundings were the inspiration of Hugh Miller's remarkable achievements in science, literature and philosophy, and the Scottish people generally, have proposed to commemorate this one-hundredth anniversary of the birth of their distinguished countryman by erecting in the town of his birth a permanent memorial of his work and worth.

It is now hoped that this proposition will meet a response sufficiently cordial and generous to justify the foundation of a Hugh Miller Institute which will serve, not alone as a resting place for the personal relics of the man, but the home of scientific collections and a library. The anniversary day, October 10, 1902, will also be commemorated by special ceremonies.

The local committee to carry into effect the centenary project has issued a circular in which the foregoing propositions are set forth, and which also contains this statement:

"The proposal has the support of the following:

"Lord Balfour of Burleigh, Secretary for Scotland; Sir Archibald Geikie, F.R.S., LL.D.; Professor Masson, LL.D.; Sir Walter Foster, M.P.; Sir John Long, M.P.; C. J. Guthrie, K.C., Sheriff of Ross and Cromarty; W. C. Smith, LL.B.; W. Robertson Nicoll, LL.D.; Arthur Bignold, Esq., M.P.; Principal Rainy, D.D.; Alexander Whyte, D.D.; Colonel Ross, C.B., of Cromarty; The Provost and Magistrates of Cromarty; Mr. James Barron, *Inverness Courier*."

No American geologist of the generation now in the full swing of its activity can have failed to come, in his early days, under the inspiration of this unique man. When textbooks of geology were few and dull, Miller portrayed in most delightful tints the beauties of the science and the charm of its philosophy. To intelligent readers of English-speaking peoples he unfolded the science in a new light; in diction his writings are a model still unattained and seldom approached by his successors; in vigor, relentless sequence, charm of anecdote and reminiscence they will never lose attractiveness and influence.

The undersigned has been asked by Mr. J. Bain, Hon. Secretary of the Hugh Miller Centenary Committee, to act as its agent in soliciting and receiving subscriptions in the United States for the end stated. Remittances will therefore be gladly received by the undersigned and acknowledgment of the same will be made by the Hon. Secretary. Checks or other orders may be made payable to

JOHN M. CLARKE,
For the Committee.
STATE HALL, ALBANY, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION B, PHYSICS.

ATTENTION is called to the coming meeting of the American Association for the Advancement of Science, in Pittsburg, Pa., June 28 to July 3. The accessibility of Pittsburg from all parts of the country and the interest which attaches to the great manufacturing industries located there, add much to the already favorable prospects for a large and important meeting. The proposed meeting of the American Physical Society in affiliation with the American Association offers an additional attraction to physicists.

It is hoped that a full and interesting program may be secured in Section B and to this end you are requested to send titles and abstracts of papers, available for this purpose, to the Secretary of the Section. Titles should be sent in time to appear in the preliminary program which will be issued several weeks prior to the meeting.

E. F. NICHOLS, *Secretary,*
Hanover, N. H.
W. S. FRANKLIN, *Vice-President,*
South Bethlehem, Pa.

BOTANICAL NOTES.

FIG GROWING IN THE UNITED STATES.

It is doubtful whether the extent to which the fig is cultivated in this country is commonly known to botanists and others interested in plants. For this reason a recent bulletin of the United States Department of Agriculture, prepared by Dr. Gustav Eisen, is of more than ordinary interest. In it the author brings together the results of his many years of personal observation and study, added to those of growers and experimenters in California. A short chapter is given to the history and botany of the fig, and although the chapter is short many botanists will find it to be one of the best available summaries. Then follow chapters on fig culture in foreign countries, fig culture in California, the caprification of the fig, propagation, diseases, drying and curing, etc. The first fig trees in California were brought by the Franciscan missionaries a century or so ago, and from these came the 'Mission figs,' a coarse but hardy and fruitful variety. Other importations of trees were made from time to time during the latter half of the past century, when the United States Department of Agriculture took the matter in hand (1894) and imported sixty-six varieties from Italy, Spain and France. About the same time importations were made also of the Blastophagæ (*i. e.,* minute insects which aid in the pollination of the flowers), without which figs can not be grown on a large scale. Still later fig trees were imported from Asia Minor, and now we are able to grow 'Smyrna figs' successfully where the Blastophagæ are present. Details of the pollination (known as 'caprification' by fig growers) are given in the fourth chapter, and here the botanists will learn many things as to the structure and physiology of the fig which are not to be found in ordinary botanical works. Chapter XV. consists of a list, in part descriptive, of the varieties of figs, including over four hundred different kinds. Near the close of the volume the statement is made that 'California alone produces now at least one half of the quantity of dried figs consumed in the United States.'

SUMMER BOTANY AT WOOD'S HOLL.

The announcement is made that the fifteenth session of the Wood's Holl Marine Biological Laboratory is to extend from July 2 to August 13. The work in botany is to be again under the general direction of Dr. Bradley M. Davis, of the University of Chicago, which is a guarantee that it will be of the high order of excellence maintained in previous years. Courses are offered on the marine algæ, the fungi, ecology, plant physiology and cytology. The usual opportunities for investigation are offered for the benefit of those who are prepared for work of this kind. At the close of the session Dr. Cowles will conduct a four-week expedition to Mt. Katahdin and the Maine coast. The supply department of the Laboratory should be more widely known, as it undertakes to furnish type material suitable for class work in high schools and colleges. The importance of this department is probably as great to the country at large as that referred to above, since this may reach a far greater number of students in distant schools. Any agency which makes possible better work in the high schools of the country affects powerfully the work in the higher institutions, and is to be encouraged.

A JOURNAL FOR STUDENTS OF MOSSES.

Four years ago a little journal was started under the name of *The Bryologist* and continued to appear quarterly until the end of 1901. The publishers then made the announcement that with the January number it was to be issued every two months. This is a sign that the support has been such as to warrant the added outlay, and is a gratifying indication of increased interest in the plants to which the journal is devoted. Looking over the numbers of the past years one can not help considering such a journal a valuable aid to the beginner, and to the older student of mosses as well. Although we have not many professional bryologues (to use the handy French word), there should be many amateurs interested in these very interesting plants, and for such particularly this little journal must be quite indispensable. On the other hand so many new species of

mosses are described in its numbers that the professional also must have access to it. Latterly the illustrations have been improved, some of the half-tones being especially fine, so that in this particular it is a desirable addition to the periodical-shelf of any botanical library. Compared with the much older French journal *Revue Bryologique,* the American publication makes a very good showing indeed, and, while perhaps not quite so technically scientific, ours is quite the superior in illustrations, printing and arrangement of matter. For this country our journal is much more useful than the French one.

THE BOTANISTS AT PITTSBURG.

IT is not too early for the botanists of the country to be planning for the Pittsburg meetings in and in connection with the American Association for the Advancement of Science, on June 30 and July 1, 2, 3. Coming so closely after the end of the college year, this should find an unusually large number of botanists free to attend the meetings, after which the practically unbroken vacation still lies before each one. On many accounts this should be a large meeting of the botanists. The place of meeting is within easy reach of both eastern and western botanists, and the region is one which should offer many botanical attractions quite out of the usual lines. If the local botanists do their duty, as doubtless they will, there should be some interesting excursions, and opportunities for the examination of recent and also of fossil vegetation. Botany includes the vegetation of the past as well as that of the present, and here will be an opportunity for studying the former which should not be allowed to pass unimproved. Botanists should not require the geologists to be the only ones interested in the plants of the earlier ages.

A NEW DISTRIBUTION OF FUNGI.

UNDER the title of 'Ohio Fungi Exsiccati,' Professor W. A. Kellerman, of the State University, Columbus, Ohio, has begun the distribution of sets of specimens of the fungi of Ohio, each accompanied by a copy of the original description of the species. Fascicles I. and II. have now appeared, and it is possible to make out the place and value such a collection will have for working botanists. In the prefatory statement accompanying the first fascicle we are told that the fascicles will appear from time to time as material may be available. "Original descriptions of all the species, or that given in connection with the first use of the binomial or technical designation, will be printed on the labels, in addition to the data usually given." Every botanist will see at once the importance of a distribution of this nature, and it is to be regretted that the edition is so small, the number of copies being but few more than those sent to working botanists. The first fascicle contains sixteen specimens, of which five are of *Puccinia,* three of *Æcidium,* four of *Cintractia,* and one each of *Peronospora, Phyllosticta, Septoria* and *Ustilago.* The second fascicle is larger, including twenty-six specimens, of which seven are species of *Puccinia,* five of *Uromyces,* three of *Ustilago,* two of *Gymnoconia,* two of *Gymnosporangium,* and one each of *Æcidium, Glœosporium, Melampsora, Piggotia, Polystictus, Stereum* and *Urocystis.* The specimens are ample and are put up in neat packets. Although these sets are intended for exchanges only, and not for sale, we are informed that a few copies may be obtained by those who wish to purchase them, at one dollar per fascicle.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

AERONAUTICS.

MR. WILBUR WRIGHT presented to the Western Society of Engineers, September 18, 1901, a notable paper describing experiments resembling those of Liliendahl, but decidedly more successful. Advances have been made rapidly in many directions during the past fifteen or twenty years in some directions of interest in connection with aeronautics. The motors have been greatly reduced in weight and special constructions have been made by Langley and others in which the motor weighs but ten pounds and even less per horse-power, where, not many years ago, weights of sixty pounds were exceptional and an engine weighing forty pounds per horse-power was a marvel. Little

more has been done in the study of the principles of safety and stability of the flying machine than was accomplished by Liliendahl, by Pilcher and by Chanute, in Germany, in England and in the United States, respectively. It is almost ten years since Maxim mounted his machine and actually flew a short distance at high speed and with disastrous results to his machine and danger to himself, and the experiment has not been repeated. Langley's experiments and discussions have provided us with a correct knowledge of the physical and the mathematical principles involved in flight, so far as measures of lift and of head resistance are concerned, but the applied theory is still to be illustrated in any full-sized and practically useful apparatus. The steadying action of the balloon is relied upon wherever, as in the case of Myers, of Frankfort, N. Y., the oldest and most successful among pioneers in this line of development, and in that of Dumont, the inventor and exploiter, one seeks to traverse the air safely. Only when stability and permanence of stability can be insured can aviation become practicable. The experiments of the Messrs. Wright, of Dayton, O., mostly conducted at the shore on the coast of North Carolina, have seemingly advanced our knowledge greatly in this direction.

The Wright apparatus is double-decked like that of Chanute, but the endeavor was to provide for direction and balance without shifting the body of the aviator with every change in the direction and force of the wind. It was found that practice would make perfect the experimenter here, as in every other field of action; that constant practice should be provided for; that the horizontal position should be assumed by the operator and that it is actually practicable; that a small steering vane could be set in advance of the aeroplanes adopted and successfully employed in directing flight and in counteracting the fluctuating action of the wind in disturbance of the position of the center of pressure on the planes; that twisting the planes is a more effective method of meeting the changes of pressure produced by wind disturbances of small extent than any system of movement of the body.

The machine finally adopted spread 308 square feet of canvas, was 22 feet long, 7 feet high and double-decked. The wings or planes were given the section observed in the wing of the pigeon, *i. e.*, slightly curved from front to rear and with the curvature sharply increased at the leading edge in a degree determined, necessarily, by experiment. Gliding or soaring was successfully attempted with this construction, in winds of velocities ranging from 11 to 27 miles an hour, and distances were attained with small elevation at the start up to a maximum range of about 400 feet; the operator finding no special difficulty in either steering or balancing the machine. The rate of drop was as low as two feet per second in some instances.

These investigations have probably disclosed a method of study of the action of the aerodrome which is comparatively safe, which permits the investigator to dispense with a motor if he so desires during the preliminary work of tracing out the principles underlying stability and safe operation of the aviator in a moving atmosphere. The work is a distinct contribution to existing knowledge in this fascinating field of research.

R. H. T.

U. S. CIVIL SERVICE EXAMINATIONS.

The Civil Service Commission announces an examination on May 6 and 7, for positions in the Philippine service of agricultural chemist, analytical chemist, physical chemist, physiological chemist and pharmacologist with salaries of $1,500 to $1,800. In announcing this examination, the Commission sends the following statement:

These examinations offer an excellent opportunity to enter a service which has many attractive features and to see a most interesting part of the world. The Philippine Service is classified, and the law contemplates promotions on the basis of merit from the lowest to the highest positions.

Thirty days' leave of absence is granted each year, exclusive of Sundays and holidays, and those employees who are promoted to $1,800 per annum are entitled to thirty-five days, or about forty days including Sundays and holidays. Leave is also cumulative, and at the end of three years those who have to their credit cumulative leave for two years may visit the United States without having

the time in going to and returning from San Francisco charged against their leave. China and Japan are near at hand and are favorite places to visit during vacations. Saturday is a half-holiday.

Appointees will be required to pay their traveling expenses to San Francisco, but the Government furnishes them transportation free of charge on its transports from that point to Manila, but exacts a charge of $1.50 a day for meals while en route, which is returned to the appointee upon his arrival at Manila. Employees who are residents of the United States at the time of their appointment shall, after six months' satisfactory service, be reimbursed for their traveling expenses from the place of their residence to the point of embarkation for Manila.

The Philippine climate is good, and nearly all of the employees are in excellent health. Medical attendance, when required, is furnished employees without cost. Good accommodations (room and board) can be secured in Manila for about $35 a month, while employees assigned outside of Manila obtain cheaper accommodations. The office accommodations in Manila are good, and the work is done under pleasant conditions.

The Commission also invites attention to the examination which will be held on April 22, for the position of assistant (scientific), Department of Agriculture.

This examination is designed for the purpose of securing persons who are qualified for the scientific work of the Department of Agriculture. Applications will be received from graduates of colleges or universities where it is shown that the applicants have pursued courses of instruction which will qualify them for the scientific work of the Department of Agriculture. Each applicant will be required to show the scope of the studies pursued and the length of time devoted to them, and his standing in each of the studies. At the time the application is filed the applicant must also submit therewith a thesis prepared by himself upon some special subject, either technical or scientific, selected by the applicant, relating to the work he is qualified to perform, or, in lieu thereof, such literature on the special subject selected as he has published over his own signature.

In connection with this examination applicants may also qualify as scientific aids in the Department of Agriculture, in order to qualify for which, however, applicants must be graduates of colleges receiving the benefits of grants of land or money from the United States, and submit with their applications the material as set forth in section 73 of the Manual. In the case of applicants for assistant it is not necessary that they be graduates of colleges receiving the benefits of grants of land or money from the United States, but they must submit with their applications the matter required by the examination for scientific aid. In addition to the foregoing, the applicants may be examined in any of the following subjects: Chemistry, (*a*) analytical, (*b*) agricultural, (*c*) industrial; physics, (*a*) especially as applied to meteorology, (*b*) soils, (*c*) irrigation; botany, plant physiology and pathology, horticulture; bacteriology (plant and animal); forestry; zoology; ornithology and mammalogy; entomology; physiology and nutrition of man; animal pathology; animal production and dairying; rural engineering, specially as applied to road making and irrigation; practice of agriculture; agricultural statistics; library science and methods.

From the eligibles resulting from this examination it is expected that certification will be made to positions in the Department of Agriculture along the lines indicated, and to other departments where similar qualifications are desired.

SCIENTIFIC NOTES AND NEWS.

THE Secretary of War has sent to the House a recommendation that Surgeon-General Sternberg be granted the rank of major-general before his retirement on reaching the age limit June next.

THE University of Edinburgh has conferred its LL.D. on Professor William James, the eminent psychologist of Harvard University, and on Dr. J. G. Schurman, president and formerly professor of philosophy at Cornell University.

PROFESSOR SIMON NEWCOMB will leave New York City for Naples on April 19.

PROFESSOR WILLIAM M. PUFFER, of the Massachusetts Institute of Technology, has returned

to Boston after a visit to Europe to inspect foreign laboratories, in view of the erection of the new laboratories of electrical engineering at the institute.

Dr. A. Graham Bell, president of the National Geographical Society, gave a dinner on April 12 to Mr. C. E. Borchgrevink, the antarctic explorer.

Dr. Andrew S. Draper, president of the University of Illinois, has been thrown from a carriage and seriously injured. One of his legs has been amputated and it is feared that his condition is serious.

King Edward has approved the award of a civil list pension of £75 per annum to Mrs. J. Viriamu Jones, widow of Principal Jones, the eminent physicist, in recognition of his services to higher education in Wales.

Professor Vambery, the well-known ethnologist of Buda Pesth, has celebrated his seventieth birthday.

The Institute of France has awarded from the Desbrousses foundation 20,000 frs. to M. Curie for his researches on radium.

Dr. W. W. Keen, professor of surgery in the Jefferson Medical College, Philadelphia, attended the recent meeting of the German Surgical Association in Berlin and was elected an honorary member of the Association.

Dr. Seaman A. Knapp has just returned from a nine months' trip as agricultural explorer for the Department of Agriculture. He visited Japan, China, the Philippines, and India, returning *via* Hawaii, where he spent a few days. The main object of his trip was the study of rice, although considerable attention was also given to other subjects bearing upon certain phases of the development of agriculture in the southern States.

Under the leadership of Mr. O. F. Cook, in charge of its tropical work, the Department of Agriculture has despatched an expedition to Guatemala and southern Mexico for the purpose of studying tropical agriculture as practiced in those countries. Rubber and coffee culture are to receive particular attention, and many interesting facts concerning the botany and the commercial cultivation of the Central American rubber tree (*Castilloa elastica*) are anticipated.

Professor C. H. Eigenmann has returned from a trip to the western part of Cuba in search of blind fishes. He was accompanied by Mr. Oscar Riddle, a senior in the Indiana University, as assistant and interpreter. The results of the trip are highly satisfactory. Many specimens of both species of blind fishes known from Cuba were secured. Their known distribution was widely extended. It has been found that the blind fishes which inhabit the caves of the interior and are immigrants from the abysmal regions of the ocean bring forth living young about an inch long. At the time of birth the eyes are well developed and may be functional; they degenerate and become covered with a thick layer of tissue with age. The fishes are becoming readjusted to living in the light in the sink holes along the courses of the underground waters.

Marshall H. Saville, curator of Central American and Mexican archeology in the American Museum of Natural History, has been exploring in Oaxaca, Mexico, since last December, under the auspices of the duc de Loubat. He has already been very successful and has found, among other things at Cuilapa, seven tombs, about a dozen stone graves, two stone drains and two lines of terra cotta tubing, as well as many jade specimens. He will return about June 1.

Nature learns from the *Victorian Naturalist* that the Central Australian expedition under the leadership of Professor Baldwin Spencer and Mr. F. J. Gillen reached the Macarthur river, Northern Territory, but was detained at Borroloola, a small township about fifty miles from the mouth of the river, owing to the foundering of the steamer which should have taken them on to Port Darwin as previously arranged. The matter of affording the expedition some relief was brought before the Commonwealth Parliament without result. However, the Premier of Victoria (Hon. A. J. Peacock) placed himself in communication with the Queensland Government, and it was arranged to send a small steamer from Normanton and bring the party on to that port,

from whence there is frequent communication with eastern Australia.

LORD AND LADY KELVIN have accepted an invitation to a reception at Columbia University on Monday evening, April 21. The reception is offered by the American Institute of Electrical Engineers and other scientific societies concerned with subjects to which Lord Kelvin has contributed, the committee of arrangements being as follows: Dr. Francis B. Crocker, *Chairman,* Past Pres. A. I. E. E.; Mr. Calvin W. Rice, *Secretary,* Chairman Com. on Meetings, A. I. E. E.; Dr. Robert S. Woodward, Past Pres. A. A. A. S. and Am. Math. Soc.; Mr. Frederick P. Keppel, Sec. Columbia University; Dr. Arthur G. Webster, Vice-Pres. Am. Phys. Society; Professor James McKeen Cattell, Pres. N. Y. Academy of Science; Mr. T. Commerford Martin, Past Pres. A. I. E. E. The reception will continue from 8:30 to 11 P.M., with addresses at about 9:30 P.M. by President Nicholas Murray, Butler, Columbia University, and eminent men of science representing the societies, to which it is expected that Lord Kelvin will reply.

THE Senate has confirmed the following executive nominations: Omenzo G. Dodge, to be a professor of mathematics in the Navy, with rank of commander, from the 17th day of December, 1899; Stimson J. Brown, to be a professor of mathematics in the Navy with the rank of captain, from the 25th day of August, 1900; Henry M. Paul, to be a professor of mathematics in the Navy with the rank of commander, from the 25th day of August, 1900; Edward K. Rawson, to be a professor of mathematics in the Navy with the rank of captain, from the 25th day of November, 1900; Aaron N. Skinner, to be a professor of mathematics in the Navy with the rank of commander, from the 25th day of November, 1900; Philip R. Alger, to be a professor of mathematics in the Navy with the rank of commander, from the 22d day of May, 1899.

THE Naples Academy has awarded its prize for natural sciences for 1901 to Dr. Marussia Bakunin, the authoress of papers dealing with stereochemistry.

DR. A. H. DOTY, health officer of the Port of New York, has received from the directors of the Pan-American Exposition at Buffalo the award of a gold medal for his exhibit on sanitation.

PRESIDENT ROOSEVELT has signed the bill restoring Dr. Edward Kershner to his rank of medical inspector in the navy. In accordance with the provisions of this act, the President has appointed Dr. Kershner to be medical inspector in the navy on the retired list.

SIR WILLIAM CHURCH has been elected for the fourth time president of the Royal College of Physicians, London.

DR. WILLIAM HUNTER, formerly assistant bacteriologist at the London Hospital, has been appointed by the Colonial Office to be Government bacteriologist at Hong Kong.

THE death is announced of Mr. Patrick T. Manson, son of Dr. Patrick Manson, on Christmas Island, whither he had gone to investigate the cause and treatment of beriberi, on behalf of the London School of Tropical Medicine.

M. EMILE RENOU, founder and director of the Meteorological Observatory at St. Mauri, died in Paris on April 7, aged eighty-seven. He was the author of numerous geographical, geological and meteorological works, and made an important scientific expedition to northern Africa in 1840.

MR. GEORGE FERGUSSON WILSON, F.R.S., the author of researches on chemistry, and also known as a horticulturist, died on March 28, aged eighty years.

THERE have also died Dr. Richard Schumacher, astronomer at the Kiel Observatory, at the age of seventy-six years; Dr. Arnulf Schurtel, professor of mining in the School of Mining at Freiburg, aged sixty-one years, and Dr. E. Miller, docent in physics in the University at Erlangen.

THE provision for the U. S. Geological Survey in the sundry civil service bill, as passed by the House, is $960,570. The debate in the House on the occasion of the passing of this item is of much interest as showing how highly the work of the survey is appreciated. The

appropriation was increased by $80,000, while the House was sitting as committee of the whole.

Dr. S. Weir Mitchell has established a prize of $50 in the School of Biology at the University of Pennsylvania, for an original investigation on the autumnal coloration of plants.

In pursuing its purpose to encourage the study of local natural history the Springfield Science Museum offers two prizes for collections of beetles. These prizes are open to children who are pupils below high school grade in any Springfield school. Specimens to show how beetles and notes are to be prepared may be seen at the museum, and two talks on 'Beetles, and How to Collect Them,' have been arranged.

The French Chamber has voted a subsidy of 25,000 frs. for the International Bureau for the unification of physiological instruments established at Paris by Professor Marey.

The Prussian government offers three prizes of the value of 5,000, 3,000 and 2,000 Marks for the best instrument for the measurement of the pressure of the wind; and a further prize of 3,000 Marks will be awarded if the instrument proves serviceable after long use. The plans must be submitted to the *Deutsche Seewarte* in Hamburg before April 15, 1903. The competition is open to foreigners.

King Edward, who is patron of the National Antarctic expedition, has contributed £100 towards the funds for the equipment of the relief ship, which must sail in June next.

The seventy-fourth meeting of German Naturalists and Physicians will be held at Carlsbad, beginning on September 21.

Dr. Lederle, president of the New York City Department of Health, has asked the board of estimate and apportionment for $1,025,000 with which to provide repairs and new hospitals for the treatment of contagious diseases.

The House of Representatives has passed a bill making the petrified forest of Arizona a national park.

A bill creating the National Appalachian Forest Reserve has been reported to the House. It authorizes the Secretary of Agriculture to purchase not more than 4,000,000 acres of mountain and forest lands in Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama and Tennessee for a forest reserve, at a cost not exceeding $10,000,000, of which $2,000,000 is appropriated by the bill.

A bill has been introduced in the Senate authorizing the establishment of a biological station on the Great Lakes, under the control of the United States Commission of Fish and Fisheries.

A bill has been introduced in the Senate by Senator Depew proposing that the United States erect a building in Paris, at a cost not exceeding $250,000, to be known as the American National Institute, on ground donated by the Municipal Council.

The physicians of Chicago are planning to erect a building for a meeting place and as a club house. It is proposed to cooperate with the John Creerar Library in the establishment of a medical library.

The growing demand for qualified teachers of nature study in the public schools has led to the foundation of a new summer school under the direction of members of the faculty of the Massachusetts Institute of Technology. The Sharon Summer School, as it is called, is designed to furnish teachers and lovers of nature with sound training in the principles of natural science and a practical knowledge of the commoner forms of living things, rather than to provide specialists with opportunities for research. The curriculum provides for fundamental work in physiography and general biology, and for elective courses on trees, wild flowers, birds, insects, mammals and seashore life. Laboratory facilities are available at the Institute of Technology, and an opportunity for outdoor study and experimentation is furnished by the control of 300 acres of natural country, in the town of Sharon, where most of the field work of the school will be carried on. Information about the course, which will be given during the four weeks following July 9, may be obtained from G. W. Field, director, or C. E. A. Winslow, secretary, Sharon Summer School, Mass. Inst. Tech.,

Boston. Among other members of the faculty of the school are Professor G. H. Barton of the Institute, Mr. J. G. Jack of the Arnold Arboretum, Mr. A. H. Kirkland and Mr. Wm. Lyman Underwood.

THE department of physics of Indiana University held a conversazione on three evenings during the recent meeting of the Southern Indiana Teachers' Association. Each demonstration required ten minutes. The following subjects were given: 'An improved interrupter with an automatic circuit maker,' used to operate X-ray tubes of highest power; 'Motion,' the bicycle wheel gyroscope, compound pendulum, etc.; the 'Nernst lamp' (the exhibit was loaned by the Nernst Lamp Co. of Pittsburg); the 'Cooper-Hewitt Vapor Lamp,' given by the consent of the inventor; the 'Speaking arc'; and 'Wireless telegraphy.' The department was especially successful in demonstrating the Hewitt lamp, considering how difficult it is to obtain the proper vacuum conditions.

THE Peary Arctic Club, having found the steam barque *Windward* unserviceable for further work in the north, has decided to install new engines and boilers. The work will be completed by June 20 and departure will be taken immediately for the north, about a month earlier than usual in order that advantage may be taken of the conditions in Smith Sound, which experience has shown are likely to be more favorable early in the season. The *Windward* expects to effect a junction with Peary, either at Etah, on the eastern side, or at Cape Sabine, his headquarters of last year on the westward side of Smith Sound, his journey to the pole and return having by the time of its arrival been accomplished.

Nature states that in connection with the survey of British lakes provided for by the Pullar Trust, Sir John Murray has rented Rannoch Lodge, standing at the west end of Loch Rannoch, from now until the commencement of the shooting season. In the first week of April the following gentlemen will join him and will be associated with him in the work, viz.: Mr. R. M. Clark, Aberdeen; Mr. T. N. Johnston, Edinburgh; Mr. James Parsons, London, and Mr. James Chumley, Edinburgh. Other appointments will be made later in the season. Sir Robert Menzies, who has taken a great interest in these investigations, and has placed boats, etc., at Sir John Murray's disposal for carrying on the work, has said that all Highland proprietors should render any assistance in their power to the survey by offering the use of boats. It is intended to include within the scope of the survey, in addition to the systematic physical and biological investigations, observations regarding the oscillations in the level of the water (phenomena called 'seiches' by Professor Forel) by means of self-registering 'limnographs,' which will be set up on the shores of the larger lakes. The first limnograph is now in process of construction in Geneva under the personal supervision of Professor Ed. Sarasin, of Geneva. It will be remembered that Mr. Laurence Pullar, of Bridge of Allan, has set aside funds to aid in carrying out this survey, as a memorial to his son, the late Mr. Fred. P. Pullar, who was engaged (in collaboration with Sir John Murray) in a systematic survey of the Scottish lakes at the time of his accidental death in February of last year.

WE learn from the London *Times* that Mr. Consul Neville Rolfe in his last report from Naples states that the subject of mosquitoes and malaria is still attracting considerable attention in Italy, more especially in the Naples district, where a large area is subject to malaria. Next to Sardinia, the province of Basilicata is the largest malarious tract in Italy, and therefore, the most interested in the extermination of the disease. The most fatal season occurs in August and September, but the further south the longer does the dangerous season continue, so that in Basilicata security can rarely be enjoyed or reckoned upon until October is past. Mosquitoes are not transported by wind, as has been often supposed, but they move from place to place on or about men or animals, and on any baggage which attracts them. This explains isolated cases and epidemics which have occurred in places distant alike from marshes and stagnant water. Some interesting cases of fever, owing to this cause, occurred at the station of

Termini, near Rome, the cases having probably originated from the mosquitoes conveyed by the Terracina train, which crosses the most deadly part of the Pontine marshes. There is a special aniline dye which when diluted even to the extent of 0.00031 per mil., is said to kill the larvæ. The well-known pastilles and powder, similar to ordinary insect-powder, which can either be burnt or distributed by means of bellows, are also mentioned. This powder is made of the flowers of the *pyrethrum roseum*, a herb extensively grown on the Dalmatian coast, the cultivation of which is being tried near Ceprano, a town about half-way between Naples and Rome. It is found that valerian root, powered and mixed with the other, renders it more efficacious. Experiments were made during last summer by Professor Grassi to combat the malady by the use of drugs. In this he has obtained a great measure of success, but the expense of the drugs and the difficulty of getting the large quantity necessary taken at regular times will form an insuperable difficulty in the case of the peasantry. Having selected one of the most malarious places in Italy, Ostia, at the mouth of the Tiber, Professor Grassi and his staff have administered six pills a day to adults, and a proportionate dose to children, the pills being composed of a compound called 'esanofele,' a harmless drug composed of quinine, arsenic, iron and bitter herbs. Dr. Grassi speaks highly of the results, and the tabulated statistics of the Ostia treatment appear very favorable.

UNIVERSITY AND EDUCATIONAL NEWS.

The litigation over the will of the late Thomas Armstrong, of Plattsburgh, N. Y., in which he bequeathed his entire estate, valued at $250,000, to Union College, has been terminated by amicable settlement outside of court. The college officials agreed to give the son of the testator one half of the estate.

Columbia University has received a bequest of $50,000 from Mrs. Lena Currier, subject to a life interest. The money is to form a fund for the purchase of books.

Washington University has let the contracts for building three additional buildings, a library, a dormitory, and a gymnasium, the approximate cost of which will be $550,000.

At the annual meeting of the board of regents of the University of Nebraska, the Omaha Medical College was affiliated. Two years of the medical work will be given in Lincoln and the clinical years at Omaha. The work will be strengthened at all points, and it is believed that the combination will result in better opportunities for medical education in this region. Dr. Henry B. Ward of the university was elected dean of the school.

At a meeting of the board of directors of the Agricultural and Mechanical College of Texas, held in Waco, April 7, 1902, David E. Houston, M.A., professor of political science in the University of Texas, was elected president. The newly elected president is thirty-six years of age, a graduate of South Carolina College in 1887, and a M.A. of Harvard University in 1892. In 1894 he was elected adjunct professor of political science in the University of Texas; advanced to associate professor in 1897; promoted to the full title in 1899, and at the same time made dean of the academic faculty. That his reputation is more than local is shown by the fact that he has already given a course of lectures before the officers and students of the Johns Hopkins University and further that his literary productions have been sought by the leading publications of our country.

Mr. J. Stuart Horner has been appointed by the corporation of McGill University its honorary representative in England. It is planned to hold an entrance examination in London next June.

At Harvard University, Dr. Charles Palache has been appointed assistant professor of mineralogy, and Dr. R. B. Dixon instructor in anthropology.

Mr. George P. Bacon, instructor in mathematics and astronomy in Beloit College has been appointed professor of physics in Wooster University.

Dr. Albert R. Sweetser has been appointed professor of biology in the State University of Oregon.